

Draft
Indigenous Knowledge for Disaster Risk Reduction in South Asia

SAARC Disaster Management Centre
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ACRONYMS AND ABBREVIATION

IK:	Indigenous knowledge
CBDRM:	Community based disaster risk management
FGD:	Focused group discussion
FGDs:	Focus Group Discussions
VDC:	Village Development community
CBO:	Community Based Organizations
NG:	Nepal Government
SDMC:	SAARC Disaster Management
IEWS:	Indigenous Early Warning Systems
JICA:	Japan International Cooperation Agency
SWOT:	Strengths Weaknesses Opportunities and Threats
SSI:	Semi Structured Interviews
B.S:	Bikram Sambat
B.C:	Before Christ

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EXECUTIVE SUMMARY

The SDMC-ADRC joint project, under the SAARC – Japan collaboration fund, on the documentation of indigenous knowledge (IK) and coping mechanism of different communities living in multi-hazard zones of South Asia is an effort to capture the valuable knowledge resources locked-up in the community domains of perennially multi-hazard prone isolated pockets in the region.

As a part of the project, the SDMC commissioned three pilot projects to document the indigenous knowledge of communities living in the seismic region of the Himalaya in Nepal, coastal hazard regions of Sri Lanka and drought as well as flood prone areas of India, in order to document, learn, revive and replicate, wherever possible, such knowledge and practices and further synergize these with modern scientific knowledge, especially in the context of promoting community based disaster risk reduction (CBDRR) strategies.

This report presents the key findings of the study conducted on the indigenous knowledge in the respective countries.

The project was taken up in two parts.

Part I: The existing literatures on the subject in the respective countries were reviewed and analyzed to examine the tangible as well as intangible impacts of IK in terms of disaster risk reduction besides analyzing integration of IK for the development of policy framework with regards to community based disaster risk reduction (CBDRR)

Part II: Field surveys were conducted in an isolated community in these three countries to find out the genesis, structure and the dynamics of IK as it exists today to draw lessons for the future.

[A] TASK ACCOMPLISHED – MAJOR HIGHLIGHTS

An account of IK in relation to disaster risk reduction has been made by:

1. preparing a bibliography of the published literature on IK on (iii) seismic risks in Nepal, (ii) coastal hazards in Sri Lanka and (i) drought and flood risk reduction in perennially flood and drought-prone regions of India;

2. preparing a bibliography of the unpublished literature or oral resources on IK covering the project areas;

3. conducting a desk review of these available published and unpublished literature on IK, which could cover the following aspects:



a. An assessment of how the communities have learnt to live with disasters (seismic & coastal hazards, floods and drought) and their traditional coping mechanisms, with particular reference to the following:
    i. Traditional technologies including housing, land use, agriculture or other technologies adopted to reduce the disaster risks;
    ii. Economic practices including savings, insurance, conservation etc for reducing the disaster risks;
    iii. Social practices like mutual help, community sharing and distribution, social security and protection of vulnerable groups like children, aged, handicapped etc to cope with the disaster situations;
    iv. Cultural and religious practices to strengthen social, mental and spiritual defence and resilience to face the disasters;
    v. Related practices relevant to the subject.

b. Strength of the IK and their relevance in the present condition;
c. Weakness of IK and how these can be removed;
d. The synergy between the IK and the modern tools and techniques for disaster risk reduction and management for strengthening the resilience of the communities living in perennially disaster prone areas.

4. conducting surveys in a group of villages in an isolated community living in the perennially disaster prone areas (Floods – Eastern Uttar Pradesh, India; Drought – Rajasthan, India; Coastal Hazards – Sri Lankan Coasts and Seismic hazard – Nepal Himalayan) , covering inter-alia the following aspects:
    - Geographic and physiographic location of the community;
    - History of the community;
    - Demographic, social and economic condition of the community;
    - The natural hazard profile that have affected the community in the past;
    - How the vulnerable community has learnt to live with disasters, with particular reference to the following:
        i. Traditional technologies including housing, land use, agricultural or other technologies adopted to reduce the risks of disasters;
        ii. Economic practices including savings, insurance, conservation etc for reducing the risks of disasters;
        iii. Social practices like mutual help, community sharing and distribution, social security and protection of vulnerable groups like children, aged, handicapped etc to cope with the disaster situations;
        iv. Cultural and religious practices to strengthen mental and social resilience to face the disaster;
        v. The perception of vulnerable communities among different age groups, sexes, educational backgrounds etc about their traditional knowledge and practices;
        vi. Brief SWOT (Strength, Weakness, Opportunities, Threat) analysis of these traditional knowledge and practices;



vii. An assessment about the aspects of the traditional knowledge and practices requiring (a) Discarded; (b) Strengthened; (c) Modified or (d) Replicated in other areas.

[B] ADOPTED METHODOLGIES

- While review works were conducted through library and internet survey, peer group discussion and review, the field studies were conducted through a survey of a group of isolated villages located in perennially disaster prone areas;
- The Investigators stayed with the community for two weeks to conduct the survey through a mix of methodologies including observation, questionnaire, interview and focused group discussion.

[C] KEY FINDINGS

The four case studies drawn from the seismic Himalayan region of Nepal, coastal hazard areas of Sri Lanka, flood and drought prone regions of India have clearly demonstrated that the communities use the indigenous knowledge to anticipate and to an extent predict natural hazard that afflicts them to prepare better to face the impact of the disaster. In case a disaster hits them, they respond, adapt and cope using their indigenous knowledge. During recovery process the community uses indigenous knowledge to bring them back to the normal and further applies this valuable knowledge resource to mitigate the risk when the next disaster hits, which in one way reduces their residual vulnerability autonomously. Indigenous knowledge thus enables a community to respond to the natural disasters in the form of anticipation, coping, adaptation and recovery. Indigenous knowledge does have limitations too, which are also important to recognize and complement with scientific knowledge. Indentifying and documenting the indigenous knowledge are quite complex and research intensive, which need development of exclusive methodologies in the different context of hazard, vulnerability and risk. While indigenous knowledge helps in enhancing resilience and coping, the real benefit of lies in channeling this resource through Community based Disaster Risk Reduction strategies, which are gaining impetus in South Asia.



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SAARC

Chapter 1

Introduction

For centuries the diverse communities in different hazard prone areas of South Asia have learnt to live, cope with and reduce the risks from various natural disasters through the indigenous knowledge (IK) they have inherited from the time tested experiences of generations and internalized through a process of socialization. Originated within communities, based on local needs and specific to the local culture and the context, this vast knowledge capital has helped in building the community resilience and enhancing their coping mechanisms. Unfortunately, this knowledge system does not find much recognition in modern disaster management theories and practices, which are increasingly driven by concepts, tools and practices, which are somewhat alien to the traditional communities. The onslaught of the so-called modern and quick fix solutions have threatened the vast pool of local knowledge with extinction and therefore it has become extremely important to research, document, revive and replicate, wherever possible, such knowledge and practices and further synergize them with modern scientific knowledge, especially in the context of promoting community based disaster risk management (CBDRM) initiatives.

1.1 Indigenous Knowledge in South Asia

South Asia is described by anthropologists as an *ethnological museum* habited by several thousand ethnic groups who speak different languages and dialects and practice almost every conceivable religion of the world.

South Asia has a landmass that can broadly be divided into five geo-physical regions - the great Himalaya-Hindukush Mountains, the Indo-Ganga-Brahmaputra plains, the desert, the peninsula and the islands and the coasts. Each region has its plethora of natural hazards. The communities living in these regions have learnt to live with the hazards, acquired intimate knowledge of the strength and limitations of local resources and developed innovative and cost effective ways of coping with them.



Mountain Ecosystems

The great Himalaya-Hindukush Mountains interspersed with large plateaus and valleys are settled by people of various ethnic and cultural backgrounds of very ancient origin. Parts of Himalayan region have witnessed some of the worst earthquakes of recorded history which caused widespread devastations of lives and property. Minor shakes of moderate to high intensities have been more frequent and people living in the mountains have learned to live with these shakes, adjusting their building design and technology to withstand them.

Floodplains

The Indo-Ganga-Brahmaputra plains that separate the Himalayas from the southern Peninsula is the world's largest flat alluvium and also one of the most densely populated areas on the earth. Formed by three distinct river systems - the Indus, the Ganga and the Brahmaputra and their numerous tributaries and distributaries - large part of this vast stretch of land get submerged during every monsoon, causing flood in numerous towns and villages particularly the low lying areas habited by the poor people and the slums in urban areas. Increasing levels of silts in the rivers and reservoirs due to denudation of forests in the hills and soil erosion and sprawling human settlements in the flood plains due to pressure of population have compounded the flood situations, which have become almost recurring annual events affecting millions of people, who have learnt to cope with the situations in their own unique ways.

Peninsular Plateau

The peninsular plateau is marked off from the plains by a mass of mountain and hill ranges varying from 460 to 1,220 metres in height. The area receives varying degree of rainfall and precipitation which are drained by the five main rivers – the Narmada, Godavari, Krishna and Kaveri and their tributaries, which sustain different types of agro-horticultural crops in different climatic zones, but large areas face acute shortage of rain or irrigation water and have to struggle with droughts at regular intervals. All these areas are habited by an amazing variety of people of different ethnic origin and aborigin, who have learnt to live with the nature in peace as well as in fury. Their intimate knowledge of nature has helped them to manage the natural resources to survive in heaviest of odds.

Desert Ecosystems

South Asian desert region primarily comprising parts of Afghanistan, India and Pakistan have been suffering in varying degrees from acute shortage of surface, sub-surface and rain water making the life of animals, plants and humans miserable and the symbiosis of their intricate relations difficult particularly during drought years often prolonging to two to three seasons. People have learnt to survive and carry on through ages of experiences passed down from generations to generations through a process of socialization, which have become part of the life style of the communities in the desert ecosystems.

Islands and Coasts

Along the coasts of Indian Ocean, Arabian Sea and Bay of Bengal, there are vast coastal areas in Bangladesh, India, Maldives, Pakistan and Sri Lanka. These coasts have a very high density of population who face the vagaries of sea, sometimes through the slow process of erosion of their land and settlement and sometime through the rapid onset of cyclonic storms which play havoc with life and environment. Many of these coastal areas now face the risks of sea level rise which have threatened the settlements of many communities. The coastal communities have learnt to live with these risks by their intimate knowledge of nature and have developed practices which are part of their life and rituals. Many of these are yet to be understood and interpreted fully. The efficacy and usefulness of the knowledge of these 'primitive' tribes in Andaman & Nicobar islands, for example, were demonstrated in the manner they saved their lives from the Indian Ocean Tsunami 2004 even though they were closest to the epicenter of the killer wave when more civilized mortals located far away perished.

Considering the importance of documentation and analysis of indigenous knowledge for disaster risk reduction at community level in South Asia, the SAARC Disaster Management (SDMC) with support from SAARC-Japan Special Fund, took up a project for documentation of indigenous knowledge (IK) and coping mechanism of different communities living in multi-hazard zones of South Asia. The project involved three pilots capturing the indigenous knowledge of the community living in:



- seismic region of the Himalaya in Nepal
- coastal hazard regions of Sri Lanka
- perennially flood as well as drought affected areas of India

The project was taken up in two parts.

Part I: The available literature on indigenous knowledge of natural hazards and coping mechanism in the three countries were reviewed and analyzed to examine their relevance for disaster risk reduction particularly in the contexts of developing a policy framework for integrating such knowledge with to the approach to community based disaster risk management (CBDRM).

Part II: Field surveys were conducted in an isolated community in these three countries to find out the genesis, structure and the dynamics of IK as it exists today to draw lessons for the future.

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CHAPTER 2

INDIGENOUS KNOWLEDGE AND DISASTER RISK REDUCTION

Indigenous knowledge refers to the unique traditional knowledge existing within and developed around the specific conditions of women and men indigenous to a particular geographic area[1]. Indigenous knowledge is often used interchangeably with local knowledge, but sometimes a distinction is drawn between the 'indigenous' to describe primitive communities living in remote areas and the 'local' to describe people or community who have lived in an area for a long period of time[2]. Such indigenous knowledge, even in primitive societies, has always been dynamic, continuously changing to adapt with the changing conditions of life and environment. As every society is always in a state of transition, the distinction between the 'indigenous' and 'local' is getting blurred, specially in the context of a globalizing world.

2.1 Definition of Indigenous Knowledge

Different scholars have defined indigenous knowledge differently but the common thread that runs through all the definitions are that it should be understood from the people's perspective of the physical environment in which they live, the natural resources they are endowed with and the ways in which these resources can be utilized optimally to cope with the challenges of the environment within the contexts of their social and cultural milieu. People find ways to live harmoniously with the environment using the knowledge they have acquired through the process of trial and error over years, decades and sometimes centuries. In their adaptation to the environment, people have developed strategies to cope with changes in the environment. These may be in the form of technology or social and economic practices or even behaviour, which are sometimes manifested in the form of

[1] Grenier, Louise (1998), Working with Indigenous Knowledge : A Guide for Researcher, International development centre : Ottawa

[2] Langill, S. (1999) *Indigenous Knowledge. A Resource Kit for Sustainable Development Researchers in Dry land Africa,* People, Land and Water Programme Initiative. Ottawa: IDRC. http://idrinfo.idrc.ca/archive/corpdocs/114518/ikkit.pdf

folklores, songs, proverbs that become part of cultural beliefs and practices. Interpretations of such beliefs and practices give a good insight about why communities act differently at given space and time[3].

2.1.1 Anthropological perspective

Therefore anthropological perspectives have assumed importance for the understanding and interpretation of indigenous knowledge. Anthropologists have thus described South Asia as an *ethnological museum* habited by more than two thousand ethnic groups who speak more than 500 languages and 2000 dialects and practice almost every conceivable religion of the world. Only the continent of Africa exceeds the linguistic, cultural and genetic diversity of South Asia but unlike in Africa most of the ethnic groups in this region are highly stratified in endogamous hereditary groups, each performing hereditary occupations and therefore the knowledge and skill associated with these occupations, which are important for coping with the hazards of nature are transferred hereditarily within the caste/tribes/sects. Hence good amount of indigenous knowledge remain confined within the social groups and horizontal transfer of knowledge across social castes, sects/sub-sects and tribal groups do not always take place. Sometimes different social groups may have different ways of coping with disasters, which are not necessarily shared with the community at large, for example in the deserts of Rajasthan different caste groups usually have their own wells or ponds which remain privy to the particular social groups. The nature, type and specifications of these assets and the knowledge associated with their construction, maintenance and use may also be different. This makes the task mapping of indigenous knowledge and resources and its replication even more difficult.

Another difficulty in indigenous knowledge is that it is transferred orally from one generation to another through a process of socialization and is internalized by the communities as part of their life style activities. Hardly ever this knowledge is documented or written down in texts or manuscripts for the posterity or outsiders. Again, local knowledge on disaster can not be segregated or compartmentalized from other knowledge system of the communities in a manner that modern day scientific knowledge on disaster is understood. The community would respond to a disaster situation almost instinctively and sometimes intuitively,

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[3] Bankoff, G. (2004) *'In the Eye of the Storm: The Social Construction of the Forces of Nature and the Climatic and Seismic Construction of God in the Philippines'*. In Journal of Southeast Asian Studies, 35(1): 91-111



which cannot be studied by the normal social science tools of observation, questionnaire, survey or even focused group discussions. Anthropologists studying local communities have reported how oral statements of people could disguise their actual risk perception and risk avoidance behaviour. For example, standard perception of natural hazards are that these are expressions of anger of the God and prayers are the best response; but when anthropologists start living with the communities they observed that the people follow a variety of locally innovative technologies and copping strategies to reduce the risks of disasters, which can be very useful in designing appropriate programmes for intervention. Even faith in God need not always be seen as a sign of fatalism; mental health experts have viewed them as extremely effective strategy for coping with psychological stress and trauma and bouncing back to life after disasters. Unfortunately, we do not have good number of anthropological studies on traditional coping strategies of the communities which the practitioners or decision makers could use to calibrate the programmes on disaster risk reduction.

Indigenous knowledge is also not something which remains static in space and time. It changes as the communities learn to adapt with the changing contexts and challenges[4]. It also varies from one area to another and within the same area from one community to another. Indigenous knowledge is essentially local knowledge which is practiced in the local situations and, therefore there would be thousands of innovative ways that the community would use and adapt such knowledge for their survival against the odds of nature.

All these inherent complexities have constrained the development of any significant literature on indigenous knowledge, particularly in the field of disaster risk reduction[5]. Even social and cultural anthropologists who have lived with various isolated communities of South Asian region to understand their life style have not documented much on disaster risk reduction as such, and even if they have done so, these are presented with so much focus on social structure, mores and rituals that a disaster management expert may find it difficult to connect for decision making.

However despite all these constraints, there is growing interest on the subject, driven primarily due to the increasing number of natural disaster events

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[4] Gupta Anil K., Indigenous Knowledge: Ways of knowing, Feeling and Doing

[5] Briggs, John. (2005). *The Use of Indigenous Knowledge in Development: Problems and Challenges.* Progress in Development Studies 5:99-114.



that are affecting the communities in various parts of South Asian region. Of late social scientists have started looking into the indigenous knowledge on disaster management, which has the prospect of enriching our understanding on the subject. There is now a growing volume of literature on the manner the communities have learnt to cope with the disasters, particularly the slow onset disasters like drought or food scarcity.

2.1.2 Attributes of Indigenous Knowledge

Indigenous knowledge on disaster risk reduction can broadly be classified in four categories: technological, economic, social and cultural.

(a) **Technological**

Indigenous technology is generally more visible and has attracted attention of environmentalists, engineers and development specialists and therefore is better documented than other aspects of knowledge on disaster risk reduction. There is now a fairly good volume of literature on indigenous water harvesting technology, management of land and cropping pattern, land use strategies and house building techniques. Society for Science and Environment has comprehensively documented the traditional water harvesting systems in various parts of India which demonstrates the ingenuity and innovation of the local communities in developing cost effective and appropriate technology using locally available resources for coping with situations of drought or scarcity of drinking water[6]. Traditional wisdom of rainwater harvesting: An overview from South Asia is yet another report brought out by Duryog Nivaran, Colombo documenting the traditional practices in water conservation.

Communities have intimate knowledge about the quality and classification of soil and the plants and seeds that are resistant to drought or flood and have developed appropriate practices for early and late cropping, inter-cropping, kitchen gardens etc. which reduces the risk of poor harvests by widening the range of crops grown. Pesticides and fertilizers made from locally available plants and other resources which enhance production in distress conditions are also well documented.

[6] Agarwal Anil and Narain Sunita (ed), Dying Wisdom- Rise, Fall and Potential of India's traditional Water Harvesting Systems, Delhi, 1997.



The land use strategies include avoiding flood or landslide prone locations when building a home and keeping away from hazardous places at certain times of year, such as not taking livestock to pasture up mountain valleys during the spring floods. To check erosion and flooding during the monsoon, villagers convert hillsides into level terraces and create outlets to manage water overflow from one terrace into another. They make check dams and a network of ponds to slow rain water run-off and save water for the dry season. They plant trees to stabilize slopes and prevent erosion of gullies.

Housing technology is another area where indigenous knowledge is much visible in every part of the South Asian region. Researchers have documented a number of indigenous building practices that have prevented collapse of structures in seismic zones, for example *Koti Banal* architecture of Uttarakhand, *Dhaji Diwari* of Kashmir, *Bhongas* of Kutch, brick-nogged wood frame constructions in Himachal Pradesh and bamboo based *Ekra* constructions in Assam, India. In the flood prone area of the north eastern India, houses have been built on stilts so that the flood waters can pass underneath. At many places, houses are constructed on raised platform so that they remain above flood levels. In the areas prone to cyclone, homes have been traditionally constructed with light weight materials that can be easily dismantled and removed. False roofs have been built where goods can be stored, if the need arises people can also take shelter when water enter houses.

(b) **Economic**

Communities have developed their indigenous economic strategies to deal with the disasters. Economic diversification had been the principle element of this strategy. Having more than one source of income or food is invaluable during times of stress and therefore, members of the rural household engaged in agriculture develop alternate skills in other works like making and selling handicrafts, carpentry, building or blacksmithing. With urbanization and globalization, a growing number of rural communities are coming to depend on cash remittances from family members who migrate to work in towns and cities, or even in other countries.

Vulnerable households store buffer food grain, livestock and cash that they can draw on in difficult times. During periods of food shortage, they will eat food of poorer quality or eat less food and look for wild foods such as seeds, nuts, roots



and berries. If a crisis becomes acute, they will begin to sell their assets like animals, tools, seeds, jewelry or even land. Having a large family can also be seen as a part of economic strategy because it gives a household additional labour for wage earning. Community thrift and credit is another useful means to fall back in distressed conditions which save families from exploitation of money lenders. Although not a traditional coping mechanism micro-credit has been huge success in many parts of the region and is actively promoted as a part of the poverty alleviation programmes especially in Bangladesh and India.

(c) Social

The social coping mechanism including kinship networks, mutual aid and self-help groups. People who are suffering from shortage of food for instance, often call upon kin, neighbours, or patrons for help. Labour and food sharing during crises is standard in many societies. Community labour in rebuilding and reconstruction is another example of social and organizational coping strategies during disasters.

(d) Cultural

This includes the worldviews and religious beliefs which helps the community in the perceiving the warning system about the disaster and provide a medium to pass on the knowledge and experience of the generations besides being the source of finding a solution to unexplainable phenomena. Above all, cultural factors act as a source of recreation for the community and help in coping with the mental trauma caused by the disaster.

Process of Indigenous Knowledge

Indigenous knowledge on disaster risk reduction develops through the processes of anticipation, coping, adaptation and recovery of the community.

- **Anticipation** is the understanding the signals of nature about the impending disaster and taking steps to prevent loss of lives and property such as moving to safer places, or building a buffer stock of grains or designing construction in a manner that suits local conditions.
- **Coping** involves facing the shocks of disaster as it comes through mutual support, alternate livelihood strategies etc.



- **Adaptation is a**n autonomous process of adjustments in life style and practices to adapt with the changing environment
- **Recovery** means bouncing back to life after disaster and preparing for the next possible disaster.

Based on their intimate knowledge of nature through years of experience communities anticipate natural hazard that afflicts them. Anticipation and prediction make the community better prepared to face the impact of the disaster[7]. When a disaster hits them, they respond, adapt and cope using their indigenous knowledge. When the impact of disaster is over, community starts to recover and return back to normal. Recovery is generally made up of post disaster activities wherein the community tries to mitigate the risk when the next disaster hits, which in one way ensure less vulnerability of the community. Hence, a community relies on their indigenous knowledge, which includes predicating the weather and the disaster by looking at the changes in the environmental condition and the animal behaviour, developing capacities to deal with the disasters, best method to preserve food, developing expertise in house building technique, developing strong ties with friends and relatives whom they can call for assistance, developing alternative source of income etc. They also best utilize the resources at their disposal like food stocks, animals, cash, jewellery, lands and other valuable items which can be borrowed, lend or sold. Communities used most of their strategies and resources before taking the help of the external agencies. So the communities having strong knowledge, skill and capacity to anticipate, cope, adapt and recover are less vulnerable to the risk of the disaster.

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[7] Briggs, John. (2005). *The Use of Indigenous Knowledge in Development: Problems and Challenges.* Progress in Development Studies 5:99-114. Agrawal, Arun. (1995**)**. "*Dismantling the Divide between Indigenous and Scientific. Knowledge*." Development and Change 6:4 3-439. http://www.unep.org/IK/PDF/IndigenousBooklet.pdf

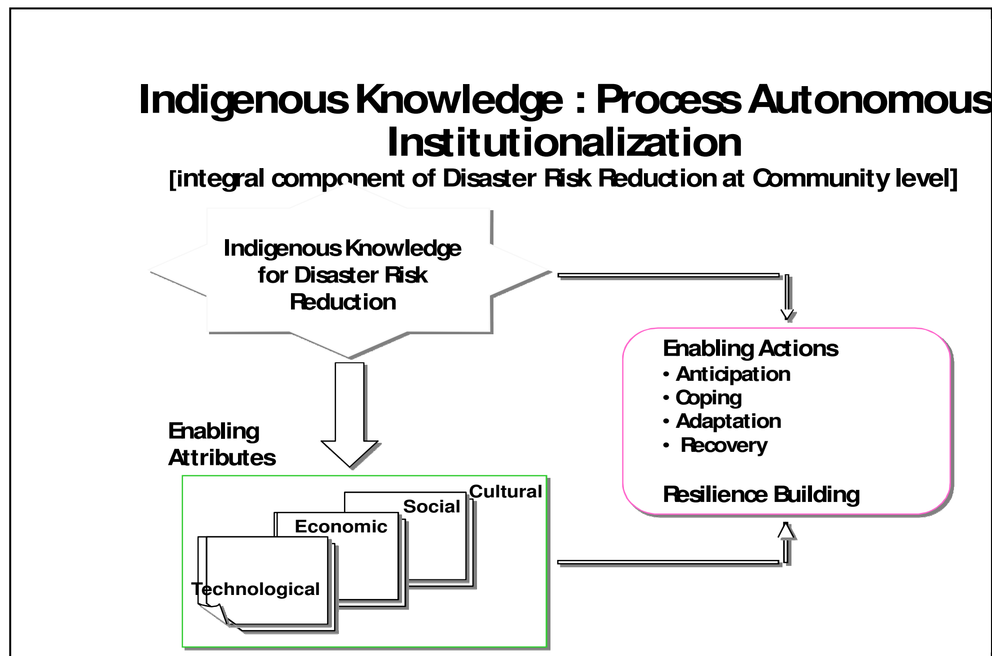


Fig 1: Process of Indigenous Knowledge on Disaster Risk Reduction

Interestingly, indigenous knowledge has been institutionalized autonomously in the community domain with the enabling attributes such as cultural, social, economic and technological factors and enabling actions in the form of anticipation, coping, adaptation and recovery, which contribute significantly in terms of building resilience in the society.

2.1.3 Documenting Indigenous Knowledge –methodology

Indigenous Knowledge is intimately embedded in the cultural belief and practices of the people. So, it is not easily seen by the outsiders. The diversity of languages in the South Asian region makes it difficult to tap into the resources available on local knowledge, as most of it are not recorded or is embedded in the old religious and cultural works[8] . It can be revealed by studying the songs, stories, proverbs, dance, myths, cultural values, beliefs, rituals, community laws, local

[8] Dekens, Julie. (2007). *Local Knowledge for Disaster Preparedness – A literature Review*. International Centre for Mountain Development: Kathmandu



language, agricultural practices, institutions of the people etc[9]. Observation, interview and focus group discussion are the well known methodologies of research.

In the context of the present study the following methodology has been adopted:

1. A bibliography of the published and unpublished literature including oral resources on IK has been prepared on (i) drought and flood risk reduction in perennially flood and drought-prone regions of India; (ii) coastal hazards in Sri Lanka; and (iii) seismic risks in Nepal;

2. A desk review of these resources has been made to

    a. Assess how the communities have learnt to live with disasters (floods, drought, coastal & seismic hazards) and their traditional coping mechanisms, with particular reference to the following:
        i. Traditional technologies including housing, land use, agriculture or other technologies adopted to reduce the disaster risks;
        ii. Economic practices including savings, insurance, conservation etc for reducing the disaster risks;
        iii. Social practices like mutual help, community sharing and distribution, social security and protection of vulnerable groups like children, aged, handicapped etc to cope with the disaster situations;
        iv. Cultural and religious practices that strengthen social, mental and spiritual defence and resilience to face the disasters;
        v. Related practices relevant to the subject.

    b. Study the strength and weakness of the IK and their relevance in the present condition;

[9] Dekens, J. (2007). The River and the Snake Don't Run Straight. Local Knowledge on Flood Preparedness in the Eastern Terai of Nepal. Kathmandu: ICIMOD Available at: www.disasterpreparedness.icimod.org



c. The synergy between the IK and the modern tools and techniques for disaster risk reduction and management for strengthening the resilience of the communities living in perennially disaster prone areas.

3. Survey in a group of villages in an isolated community living in the perennially disaster prone areas (Seismic hazard – Nepal Himalayan, Coastal Hazards – Sri Lankan Coasts, Drought – Rajasthan, India and Floods – Eastern Uttar Pradesh, India) , covering inter-alia the following aspects:
   - Geographic and physiographic location of the community;
   - History of the community;
   - Demographic, social and economic condition of the community;
   - The natural hazard profile that have affected the community in the past;
   - How the vulnerable community has learnt to live with disasters, with particular reference to the technological, social, economic and cultural practices for disaster risk reduction including housing, land use, agricultural or other technologies adopted to reduce the risks of disasters;

The Investigators stayed with the community for two weeks to conduct the survey through a mix of methodologies including observation, questionnaire and interview, and focused group discussion. The results of the desk review and field studies are stated in the chapters that follow.

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CHAPTER 3

INDIGENOUS KNOWLEDGE ON EARTHQUAKE RESISTANT HOUSING TECHNOLOGY IN NEPAL

3.1 An Overview of Cultural Beliefs and Practices Regarding Earthquake in Nepal

Nepal is a nation of different races and ethnic groups with their own raditions and religious faith. It is one of the ancient civilizations of the world. The culture of Nepal has evolved over centuries. This multidimensional cultural heritage encompasses within itself cultural diversities of various ethnic, tribal, and social groups, located at different altitudes, and is also manifested in various other forms, including music and dance; art and craft; folklores and folktales; languages and literature; philosophy and religion; festivals and celebrations; and foods and drinks. Nepal has a rich tradition of storytelling and the historical events that are described in several family trees. Surprisingly, in these writings and inscriptions, references to damage by historical earthquakes are found few and far between. Historical records of earthquakes preserved in different form such as written history, chronicles, inscriptions etc. in Nepal.

Historical records reveals that one third to one fourth of the population of Katmandu have been killed besides destroying many houses and temples by the earthquake which occurred in 1255. Other earthquakes which have devastating effects are earthquake of 1408, 1681, 1810 and 1833. In 1934 there was also a major earthquake killing many people. From the record of previous earthquakes, it has been observed that there is a threat of a major earthquake every 75 years in Nepal. Based on the statistical data, the Himalayan region is likely to get another shocking quake in the near future. Thus earthquake has been a part of life of people of Nepal. There are numbers of local poetry '*sawai*' written in remembrance of 1934 earthquake. One of such Sawai published as '*Lokmanjari*': the folk-bud by Lok Nath Pokharel has explained about the devastation of earthquake of 1934 which is known by earthquake of '*Nabbesaal'*. *Nabbesaal* is translated as year of Ninety which is 1990 BS. BS is *Bikram Sambat*, which is the official calendar still



being practiced in Nepal. The folklore in form of poetry has shaded the lights on earthquake of Nabbesaal and has minutely explained about vulnerability. In one of the stanzas of Lokmanjari it is written that local technology and small huts are less vulnerable and the poet has prescribed to have one such hut for each family[1].

3.1.1 Beliefs and practices

Earthquake is caused due to God's anger against the sin of the people on the earth. It is also commonly believed that the goddess earth fells overloaded and she wants to change her position due to which earthquake occurs. Another consideration of the local people about the earthquake is about the snake king '*Shesh Naag*' having 1000 heads who is holding the planet earth on one of his head. When he gets tired and wants to change it position, earthquake happens. All such examples are somehow related to the religious belief which means that there is a strong hold of culture in terms of understanding earthquake in Nepalese context. Nepal has been heavily influenced by ancient Hindu practices, the culture of relating knowledge with religion is felt dominating. Everything is god…as one of the mythological heroes Lord Krishna of Hindu in *Bhagbat Geeta* presents himself as omnipresent. This is how nature is observed in Nepal. Even non-living things like books, coins, building elements, structural parts are also considered to be the incarnation of one of the gods Hindus worship. This culture of worshipping of such living and some non-living objects has a strong logic of obeying the local knowledge whether it might be natural or man-made, but unfortunately they are ignored in present day livelihood. In Nepalese context, it is hard to segregate the local knowledge from cultural practices[2].

The people inhabit ting the rugged Himalayan terrain in Nepal had witnessed the fury of earthquakes ever since they chose to settle in this land and accepting the challenge put forth by nature they attempted ways of protecting them and their community from the wrath of nature. There exist evidences to show that the elements of earthquake-resistant structural designs had evolved. Despite being

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[1] Marahatta, Punya Sagar.(2007). *Cultural Capital for Earthquake Vulnerability Reduction: The case of Kathmandu Valley*. Thesis for Master's programme in urban management and development.

[2] Marahatta, Punya Sagar.(2007). *Cultural Capital for Earthquake Vulnerability Reduction: The case of Kathmandu Valley*. Thesis for Master's programme in urban management and development.



located in seismically active zone, multi-storeyed houses have been constructed. The development of technology of building in Kathmandu Valley would have been a continuous attempt to respond to earthquakes, which has been a recurrent natural phenomenon. The technologies are transferred from generation to generation but are confined to the specific group of people who are specialised in the field of building houses.

Some of the evidences which show the earthquake resistant technology are the buildings in the Solukhumbu region which have vertical and horizontal timber posts embedded in the masonry. The double framed doors and windows act as reinforced openings. Buildings in and around Kali Gandaki valley have unique detailing for supporting the floor. Vertical posts are erected at strategic points along the walls to support the flooring system. Each floor is supported by different framing systems independent to each other. Thus the wall is only partially used to support the flooring and used as the curtain wall. The Gurungs and Magars of the central part of the hill area used to make oval shaped or circular buildings with a sloping roof in the past. Some of the houses surveyed were more than 150 years old. These buildings are relatively stronger than the conventional rectangular buildings. These show that incorporation of earthquake resistant elements in building construction was prevalent in different parts of Nepal as Solukhumbu is located in the Everest region of Nepal, while the Kali Gandaki Valley lies in central Nepal and Gurungs and Magars are the local ethnic groups spread over the entire central Nepal from east to west. One fine example of earthquake resistant technology is Nyatapola, five tired temple at Bhaktapur which was less impacted with several earthquakes. It is standing since 300 yrs because it has got a grand plinth. This plinth was made after the lesson they learnt from other temples in valley which were destroyed during previous earthquakes.

Socio-cultural response

Earthquakes have cultural responses too because during earthquake people tend to evacuate themselves to the open spaces by shouting *Narasimha*- the name of earthquake god, which was nothing but alarming other people who might not have felt the earthquake. The culture of leaving socially agreed space for public use by the name la: chhi[3] has been historically documented to be the most useful space during earthquake time[4]. Another non- technical aspect of cultural practice is

[3] La Chhi is a socially agreed set back left on the streets on medieval towns of Kathmandu which creates open space in street intervals. Refer picture of La Chhi in annex.

[4] Commented by Prof Tiwari in Punya Sagar Marahatta, 2007:Cultural Capital for Earthquake Vulnerability Reduction: The case of Kathmandu Valley



the system of 'Guthi'. The Guthi (collective endowment established by the community) system plays a very important role. Guthi is an age-old tradition. Although Guthi was overwhelmingly present in the Kathmandu valley, it is found everywhere in Nepal, especially around religious shrines and traditional settlements. In order to conserve the time old charity tradition, the Guthi Corporation was created and is running until the present time. In fact, they are very strong cohesive factors uniting several segments of society. The temples and rest houses run by the Guthis are venue for socio-religious functions including marriages, initiation ceremonies and other kinds of social feasting, in times of peace. In times of calamities these venues provide excellent rescue and relief sites. Thus the Guthis are useful both during peace and disaster.

Rituals, festivals and religious celebrations are the integral part of the society in all walk of live of Nepalese people. Some of such cultural practices have been devoted in Kathmandu valley for the regular maintenance of public spaces, water reservoirs and even the public buildings. One of such festivals is called as *Sithi Nakha*, a pre-monsoon festival which was observed for up-keeping of urban services, building services and structures. This was done annually which was very much useful to observe the life of the building every year and repair it as needed. This had made the building strong during monsoon and perhaps this could have made it a kind of earthquake resistant too. Another festival is *Naag Panchami*. During the festival, people offer milk to the snakes, their idols and pictures. This festival may be related with the belief of the people that earthquake are caused due to snake king which held the earth on its head.

The traditional architecture of Kathmandu valley has the symbolic representation of serpents on the wall, over the door, on the struts, etc. these somehow symbolically represents the cultural and religious belief of the people. This belief has eventually interpreted and represented in the form of the serpent bands around the building structure. It is a generally a structural band of carved timber fixed between two brick masonry works and work effectively against shocks and quakes. Therefore, it could be said that the local knowledge of using timber bands around the buildings has a scientific logic behind it and symbolically represents of snake in the cultural believes.

3.1.2 Technological features of earthquake resistant housing



The traditional system of "occupational castes" for example, "Sikarmi" (carpenter), "Dakarmi" (mason), "Lohakarmi" (blacksmith) etc was the basis for continuation of the traditional skills and wisdom and their continued application and integration into the building construction process, by passing the knowledge from generation to generation. Unfortunately, loss of the "caste" system, which otherwise is regarded progressive, has contributed too much misunderstanding of the logic behind the use of a particular element of construction, and the traditional methods have been turned into rituals. This has led to even misplacement or wrong placement, or partial placement of a certain element without proper integrity. The development of technology of building in Kathmandu Valley would have been a continuous attempt to respond to earthquakes, which has been a recurrent natural phenomenon.

An assessment of different typology of building was conducted by using micro-tremor measurements as a part of the study on Earthquake Disaster Mitigation in the Kathmandu Valley by a team led by Japanese specialists, JICA. The survey results conclude:

"Traditionally made brick in mud structures are stronger than expected and will not generate pancake destruction like RC frame structure (poorly build). These results lead us to conclude that over 40% traditional masonry remained unaffected seriously in the 1934 earthquake, even in the strongly shaken area. Furthermore, the courtyard building with symmetrical shape is considered strong".

Following earthquake resistant measures were found in traditional technologies:

1. **Configuration:** Most of the buildings are rectangular. These simple and symmetric configurations in plan make the building more stable. This causes no excessive torsion because the centre of mass and center of rigidity coincides in the building.
2. **Length to breadth ratio**: In most of the buildings the length to breadth ratio is 2 or less.
3. **Openings:** Openings are relatively small and symmetrically located. The small openings increase the length of the facade and substantially increase the stiffness of the building.
4. **Double framing of opening**: Buildings have two complete frames of timber around the openings to strengthen it against lateral force.



5. **Wall thickness**: Wall thickness at the ground floor is 45 centimeters. Thickness decreases with succeeding upper floors. As the horizontal thrust at the ground level develops highest at the time of earthquake in the building, the greater thickness reduces the shear failure at that time.
6. **Floor height**: In all cases the storey height was found less than 2.5m
7. **Number of stories**: Most of the buildings are three stories.
8. **Wooden bands**: Wooden bands around the building at sill level, lintel level and at the floor level can be found curved as "Naga". These bands protect the walls from out of plane failures as well as provide integrity between different structural elements by connecting orthogonal walls. Also building act as monolithic, so that earthquake force is resisted by the building as complete unit rather than by individual part.
9. **Vertical post at corners**: These vertical posts at corners act as vertical tensile reinforcement. This protects the building from damage due to tensile cracks in the building. In some cases they provide some redundancy in the system which is very useful to withstand earthquake force.
10. **Struts**: Struts are long wooden planks which support the overhanging roof of the temple. It transfers the load of the roof to the vertical load bearing wall.
11. **Wooden corner stitch**: In addition to wooden bands, corner stitch can be found which connects orthogonal walls and protects from separation at corners.
12. **Wooden pegs**: Proper connection of all wooden elements by wooden pegs can be seen in traditional buildings, which helps for proper connection of roof and floor with wall as well as the different elements of roof or floor.
13. **Boxing of opening**: Boxing of opening by wooden frames, either all around or along both edges of the masonry wall provided strength around the opening.
14. **Reducing load consecutively in upper floors**: There are the reduction of the wall thickness in upper floors due to lesser load carrying requirement and the use of light partition walls, second and third floor central walls are often total timber frames. This reduces dead load of upper floor and gives more shear strength to the spine.



15. **Plinth**: Mostly on temples, foundation design for tall temples was changed into massive multiple plinths. These improve response against wave amplification and avoid resonance with ground.
16. **Numbers of tiers**: The Nepalese construction rarely use even number of floors for constructing higher buildings. Experiments with model have shown that a five tired temple comes to rest faster than four tired temples, when subjected to similar vibrations. Use of odd number of floors appears to have contributed to its strength against.

The following earthquake resistant measures are found in traditional technologies in different parts of Nepal.

1. The buildings in the Solukhumbu region have vertical and horizontal timber posts embedded in the masonry. The double framed doors and windows act as reinforced openings.
2. Buildings in and around Kali Gandaki valley have unique detailing for supporting the floor. Vertical posts are erected at strategic points along the walls to support the flooring system. Each floor is supported by different framing systems independent to each other. Thus the wall is only partially used to support the flooring and used as the curtain wall.
3. The Gurungs and Magars of the central part of the hill area used to make oval shaped or circular buildings with a sloping roof in the past. Some of the houses surveyed were more than 150 years old. These buildings are relatively stronger than the conventional rectangular buildings.
4. These show that incorporation of earthquake resistant elements in building construction was prevalent in different parts of Nepal as Solukhumbu is located in the Everest region of Nepal, while the Kali Gandaki Valley lies in central Nepal and Gurungs and Magars are the local ethnic groups spread over the entire central Nepal from east to west.

The deficiency elements for earthquake resistant measures in traditional technologies are listed below:

1. **Soil and foundation**: The buildings have shallow foundation and depth varies from 1 to 3 meters. This is insufficient for the type of soil in Kathmandu Valley. The soil is alluvial, prone to liquefaction, and tends to amplify earthquake forces.



2. **Wall:** Wall structure was always built in mud mortar with three layers. Outer and inner face layers were not well connected with the middle core wall. Normally the middle core was filled with rubbles and mud, which makes wall very poor to hold the heavy load from the main structure. The quality of the bricks was always good on the exterior surface, but normally for interior walls inferior bricks were used. In many places, fired bricks were used only for the exterior while for the interior and middle fill, simple sun-dried bricks and rubbles were used.
3. **Shape:** Most of the buildings are simple and symmetric in plan. However, they can be slender and thus vulnerable to damage.
4. **Hammering effect:** In urban most of the buildings are joined together to form blocks, Hence during severe earthquake, when all buildings shake according to their own natural period of vibration, hammering action between adjoining houses can take place.
5. **Material:** Sun dried bricks used for walls in buildings are brittle in nature and cannot take tensile stresses incurred during earthquake, thus resulting in large cracks or collapsing of walls. Also the quality of mortar is poor.
6. **Heavy roof and flooring:** In many buildings roof is held relatively tightly to wall by use of wedges and tie members. However, roof is heavy due to use of thick layer of mud and heavy tiles that can create problems as bigger the reactive masses of the building, the bigger is the earthquake forces.
7. **Workmanship and maintenance:** Professionals are not generally used for designing building. Construction is performed entirely by hand. The labor forces are usually not skilled and the quality of equipment is poor. The climate with heavy monsoon rains places several demands on materials. In some cases, no measures are taken until the building finally falls down.



Small and symmetrically openings & low floor height



Wooden pegs





Wooden bands



Struts





Double framing at opening



Multiple Plinth

3.1.3 Economic practices

One of the principal elements in this category is economic diversification. Having more than one source of income (or food) is invaluable during times of stress, when some economic activities become impossible. Members of a rural household engaged in agriculture undertake other work, such as making and selling handicrafts, carpentry, building or blacksmithing and labor works. With urbanization and globalization, a growing number of rural communities are coming to depend on cash remittances from family members who have gone to work in towns and cities, or even in other countries. Vulnerable households try to store up a 'buffer' of food, grain, livestock and cash that they can draw on in difficult times. If a crisis becomes acute, they will begin to sell their assets, but sale of livelihood assets (e.g. animals, tools, seeds for planting next year's crop or even land) is seen as a last resort. Even having a large family can be seen as part of an economic coping strategy because it gives a household additional labor. Savings and credit schemes are often an important component of economic coping strategies

3.1.4 Formal and Informal Loan System

Most of the people are keen on investment, even with small amount of money. The main sectors of investment are shops, livestock farming, transportation, cash-crops etc. If somebody needs or wants loan to do business, the loans are easily available. People take loans from individuals (moneylenders) or friends. It is informal and depends on trust. No one does any paper work or collateral contract during the process. Majority of people have a culture to return the loan and work sincerely on business. Even if the lender is a friend or relatives and do not ask for interest, most of the burrowers return money at a minimum interest. There are also formal loan systems such as finance companies, corporative and banks. But these organizations need collateral. As these organizations do not extend time, in case people fail to return the loan on time, their property in collateral will be lost. But in informal loans, if one cannot return the money on time they can extend the time. Therefore, the informal loan system is quite popular in rural parts. Generally people take loans either for business, or to go to abroad for jobs or for cultural ceremonies like marriage, funeral, etc. However, no one takes formal loan after disaster damage to meet their daily expenditures or to make house or to invest in agriculture. According to the local people, it is because, for formal loans it requires collateral and no one takes flood- affected houses or lands as collateral. Economically capable people take informal loans to do business, which indirectly helps for the post disaster-economic recovery rather than for daily needs.

Poor people (whose income source depends on daily wages) generally do not get loans easily. Moneylenders do not think that burrowers could return the money unless they could provide any collateral. These poor victims take loans (only small amounts) from their relatives in case of extreme need, like disasters, as a relief. Therefore, informal loan system is one of the factors that enhance the adaptive capacity of victims for economic crisis. Disaster-affected people may also appeal to the wider community for charity. In many communities, gifts or alms are expected at times of hardship.

Historically different communities have coexisted with mutual help and cooperation in Nepal. There has been a cultural and religious tolerance. In particular Hindus and Buddhists have been visiting the temples and the monasteries and worshipping each other's Gods and Goddesses. There has been tradition of self-help organization such as the Guthi among the Newars, ' Bheja' among the Magars of the hilly part of Nawalparasi and adjoining region of Palpa districts.

3.1.5 Guthi- A community based organization

In the socio-economic composition of the Nepalese society, the Guthi (collective endowment established by the community) system plays a very important role. Guthi is an age-old tradition. Although Guthi was overwhelmingly present in the Kathmandu valley, it is found everywhere in Nepal, especially around religious shrines and traditional settlements. In order to conserve the time old charity tradition, the Guthi Corporation was created and is running until the present time. Broadly speaking any person or a group of persons with social service motto or religious reasons join together and voluntarily create an endowment/Guthi by offering private property, cash or kind including landed property for sake of sustaining worship in temples, maintenance of public rest houses for pilgrims and several other socio-religious functions. Such landed and other immovable property is so vast that the Guthi Corporation runs braches in 11 districts and the Land Revenue District Office of HMG looks after this in 60 districts (Guthi Corporation Inventory, 1999).

The inventory lists the following statistics:

Description	Location/types	Quantity
Guthi owned land property	Hill	5,16,332 Ropani
	Tarai	41273.125 Ha (66037 Bigha)
Guthi managed public properties	Temples	712
	Rest Houses	647
	Ponds	159
No. of Guthis	Throughout Nepal	4,164
	Kathmandu Valley	1,113
	Kathmandu District	651
	Lalitpur District	161
	Bhaktapur District	301

Note:

1 Ropani = 5476 sq. ft. (508.7 sq. m)
1 Bigha = 6250 sq. m.

Forms of Guthi

Basically there are four forms of Guthi:

a. Religious Guthi
b. Guthi for Social Services
c. Guthi for Entertainment
d. Caste Guthi

The Guthis appear to be religious in nature but they perform innumerable social functions. In fact, they are very strong cohesive factors uniting several segments of society. The temples and rest houses run by the Guthis are venue for socio-religious functions including marriages, initiation ceremonies and other kinds of social feasting, in times of peace. In times of calamities these venues provide excellent rescue and relief sites. Thus the Guthis are useful both during peace and disaster.



Newars were the native people of Kathmandu valley in the past, and a quick review of their Guthi system will be of great importance to understand how the Newar society is still organized and their values and norms are greatly influenced by the guthi which still acts as an anchor. As these Guthis are religious in sentiment and cohesive in social structure, they can be of immense help during disaster. But Guthis are not popular in new settlements.

Guthi – Among the Newars

Guthi is derived from the term "Gosthi" meaning an organization with the socio-cultural and religious character. While caste or sub-caste sets the limit to the general status-position of a person in the total society, his ritual and social life is regulated and controlled through these 'guthi' institutions. The Newar society is notable for its numerous Guthi institutions which grant memberships to the individual household groups. These Guthis divide the Newars horizontally in a number of groups for achieving different objectives.

Lichchhavi period (1st to 8th century) is the base period of present Guthi organization among Newars. During this period, Guthi had important role to play on the social and religious life. Following the Lichchhavi period, during the medieval period too, Guthi was mainly concerned with social rites and rituals. Guthis could be seen as the important institutions which had a great role to preserve the temples constructed during the medieval period. Each Newar in one way or the other is associated with his Guthi in his society. It is generally ascribed by his family tradition. Each Guthi has its own rules and regulations which must be strictly observed by its members.

In the event of sanctions imposed by any of the Guthis, the social living of a defaulting household becomes quite miserable. Guthis are classified according to the functions they perform, such as religious, social and cultural functions.

The entire network of social relations in the Newar community is kept strong through the feasts and festivals under the auspices of the various guthis. These feasts and festivals are numerous. It is through the participation in these feasts that a Newar individual enjoys the protection of the society. Solidarity is sought to be maintained through the feasts and festivals on four different levels – family, patrilinial groupings, caste and community. On the other hand, the feasts and festivals not only affect the integration of different living individuals but also act as

a bridge between the living and the dead. In the Newar social organization, the living and the dead both go to make the social group. Thus the sum total of Newar culture traits goes to make such an institutional complex that there is complete integration of the individual with the society.

3.1.6 Social ties among the neighbours

Social ties are very strong in Nepal during the emergency events. Social structure is based on the belief in helping each other during the need. Neighbors and villagers are the first to provide moral support and financial assistances (as per their capacity). Whether the victim is poor or rich, the society and neighbors help at their level to rescue and relief during a disaster. The neighbors raise fund immediately in the neighborhood to help the victims. In villages, people are very much organized and united. The people of same cast live in the same community (*gaun* in Nepali). Therefore, people are more united within a caste, then within different castes in a village and then among neighboring villages. During emergencies the first one to help would be the neighbors from the same caste. If a disaster is large then the neighbors of different caste will help and if the extent of damage is very large and if they need more help, then the villagers from neighboring villages get together to help the victims. Sometimes, the help is so large that poor victims may get more than what they lose. Many victim families during the post-disaster receive economic support from the relatives, which will increase their adaptive capacity to some extent. The victims who had good support from the relatives will suffer less during the economic recovery.

3.1.7 Mit (Traditional Bondage of Friendship) system

Mit system is an example of social network as a support for the post-disaster recovery. *Mit* literally means a type of formal and societal friendship between two persons of same sex. This relationship can be inter-caste or between different economic status. Once the two persons are bounded in this friendship, the two friends call each other *Mit*. When two persons become intimate (*Ghanistha*) and do everything together, their guardians generally propose to make them *Mit*. *Mit* has religious and societal value and this relation is established in different traditional ways. Some make this relation by worshiping the god and during this process they interchange clothes and small amount of money with each other. Others make *Mit* by hugging each other in the presence of their elders. In this relationship, all the relatives of one will have same relation of the second and vice versa. For example, one Mit's mother/father will also be the other's mother/father and will be called as



Mit-mother/ *Mit-father*. The *Mits* have social responsibility for each other and should follow certain religious and traditional cultures. They become relatives after the relationship. In the *Mit* system, if one *Mit* is in mourning on somebody's death then another should follow the mourning as well. Similarly, marriages are not allowed between these two families of *Mits* and this applies up to three future generations.

Apart from these, local organization such as the clubs, youth associations, religious groups (Bhajan Mandals, Dafa), social groups and any movements and the likes, which are at the grassroots level are also different forms of social network that play crucial role in post disaster recovery.

3.1.8 Cultural and religious practices

Religious activities, such as prayers and collective gatherings, are also be part of long-term coping strategies to natural hazards by providing rules for wise natural resource management.

While building a new house they perform certain Puja (religious ceremony) during the foundation ceremony with a belief that it will make the house stronger and resilient to any disasters. The house worship is done while placing the foundation. And during that Puja they keep small artifact of tortoise with a belief of making the foundation as strong as the shell of the tortoise.

3.1.9 Strength and weakness of Indigenous Knowledge

Coping strategies and indigenous knowledge are important in reducing risk. But like any knowledge system, they have their strengths and weaknesses in different contexts and at different times. Local knowledge, skills and coping strategies must be assessed rationally and scientifically on the basis of their effectiveness. It is not a debate between indigenous/traditional and external/scientific/modern systems in themselves, but a question of finding the most appropriate approach for each situation.

Understanding local knowledge and practices can help identify what is needed and acceptable locally and how people’s participation can be solicited to ensure their support for external action. Building on local knowledge and practices (i.e., capitalizing on local strengths), when it is relevant to do so, can decrease



dependency on external aid. Local people provide continuity and can monitor the actions taken.

Even from the social point of view, taking local knowledge and practices into account promotes mutual trust, acceptability, common understanding, and the community's sense of ownership and self-confidence. Understanding local knowledge, practices, and contexts helps development and research organizations to tailor their project activities and communication strategies to local partners' needs. It also enables development research organizations to act as intermediaries in translating messages from government level to communities in a way that is understandable and credible.

Just as all adjustments are not sustainable, not all beliefs are sustainable or relevant. They can act in a negative or dysfunctional way. The local beliefs (and related practices) can have both positive and negative effects on disaster preparedness. Disaster preparedness programs need to capitalize on cultural aspects that contribute strengths and moderate them when they create obstacles[5]. Belief systems are also dynamic and constantly changing due to internal and external influences.

Study, exploration and analysis are necessary not only because people continue living in such traditional constructions and therefore continue building such construction in the foreseeable future, but also because several of the building typologies are not fully understood and described, and that it is necessary to make statement on seismic stability of such buildings. It is a paradox that the 3-4 storied buildings in bricks and mud mortar, which are standing in the developing world for centuries; do not have adequate methodologies for appropriate design and analysis while such methods are available for 30-storey high buildings.

Scientific authentication of seismic behavior is needed before propagating or revitalizing the traditional concepts – it should not be a blind copying process. Affordability, acceptability, and the ease in implementation as well as in communicating the knowledge should perhaps be some of the criteria for selecting the concepts for scientific researches.

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[5] Bankoff,G. (2004). *In the Eye of the Storm: The Social Construction of the Forces of Nature and the Climatic and Seismic Construction of God in the Philippines*. In Journal of Southeast Asian Studies, 35(1): 91-111. http://www.hull.ac.uk/history/Staff/Academic/eyeofstormnew.pdf

In addition geological mapping and monitoring are also needed to identify fault lines and areas liable to seismic activity – local knowledge cannot manage this. It is also unrealistic to expect indigenous strategies to be able to cope with extreme events.

3.2 A Field Study and Analysis of Indigenous Knowledge Practices

This is a report of survey conducted in two communities in Kathmandu Valley on the indigenous knowledge and practices for disaster risk reduction particularly for earthquake resistant housing. The surveys were conducted in Nangkhel village, a rural community in Bhaktapur district and Golmadhi tole, Ward No. 7 in Bhaktapur city, an urban community of Bhaktapur Municipality, in seismically hazardous area of Kathmandu Valley.

The main goal of the survey is to contribute towards documentation, learning, revival and replication wherever possible the indigenous knowledge and practices

The following are the objectives of the survey:

- To find out the genesis, structure and the dynamics of indigenous knowledge and practices used by the community as coping mechanisms for disaster risk reduction.
- To analyze those indigenous knowledge and practices
- To recommend for adoption, adaption and replication

3.2.1. Methodology

An interpretive methodology, which deals with explaining meanings and human experience, was adopted in this survey/study as a philosophical framework as the survey requires an empirical investigation of the village community within its real life context.

A variety of qualitative techniques and data sources were used for gathering information and analysis to make it compatible to the nature of survey. The techniques adopted to conduct the survey include observation, interview and focused group discussion (FGD) while data analysis was done by SWOT analysis

and reflection. Nepali and even Newari, a local language wherever needed were used.

Focus group discussion

Focus group discussion was carried out in Bhubaneshwori Lower Secondary School at Nandikeshwar Mahadevsthan in Nangkhel and Bhaktapur separately. The participants were primarily masons and house owners of different age and sex groups. They were divided into two groups, one of masons and other of house owners. A checklist was developed considering the earthquake resistant elements, technology and its perception, transfer of knowledge and practices, socio-economic, cultural, religious institutions, practices and mechanisms to cope up with the disaster in the community. It was used in during observation, interview and focus group discussion methods.

Interview

Two people were interviewed, one from mason and one from the house owner group in each community.

Observation

Investigator's observation in the field visit and during interactions with the community was another technique used in this study. Observation complements FGD and sometimes it is 'more reliable than what people say'. During fieldwork and FGD, it acts as a more objective record to supplement the data/information. The investigators participate as passive observers to see the community from the insider's perspective.

Reflection

Reflection in survey refers to all the process of analysis and interpretation that the investigator is engaged to reach an explanatory understanding of the subject matter. It is an ongoing process embedded in data analysis and used throughout this survey as a technique of data analysis.

SWOT

The data and the information gathered on indigenous knowledge and practices were analyzed from strengths, weaknesses, opportunities and threats to Earthquake Resistant Housing Technology points of view.

3.2.2 Study area

Nangkhel is a rural community in Ward Number 2 of Nangkhel VDC, close to Bhaktapur town. It lies at the north slope of a mountain capped with dense forest at the southern boundary. It is located in south east of Kathmandu Valley and is 15 km far from Kathmandu city with all black topped road access about 2.7 km earthen road. Nangkhel community has two main settlements separated apart by approximately 400 meter.
Golmadhi Tole is in Ward No. 7 of Bhaktapur Municipality. The ward covers an area of 0.1518 sq. km and stretches from low land to the high with some slope land in-between. Bhaktapur town is situated in the east of Kathmandu valley and is accessible by a 12 km black topped road from Kathmandu city.

3.2.3 Historical background

The settlement of Nangkhel is believed to be more than 100 years old. It was an agricultural land owned by the people of Bhaktapur and gradually got migrated in due course of time. People of fourth/fifth generations have been living here.



Fig 2.1: Location of Survey Areas in Kathmandu Valley

Golmadhi being a part of Bhaktapur town, its history dates back as of the town itself. Bhaktapur is a smallest of the three old royal Malla towns of the Kathmandu Valley and is believed to have been founded in the 9th century. It became the seat of cultural, economic, and political power due to a number of favorable factors. One of the factors was its location on a former trade route between India and Tibet. A surrounding fertile agricultural belt also provides an added impetus to the overall economic well being of its populace.

3.2.4 Demography

According to the 2001 census, Ward No 2 of Nangkhel V.D.C. has a total projected population of 856 of which 442 are male and 414 female. As per the age

distribution data the number of people of age 16-44 is the highest. There are around 134 households among which more than 100 households are in Nangkhel village itself. The total projected population of the Golmadhi Tole as per 2001 census is 4,181 of which 2,114 are male and 2,067 female. The ward has a total number 579 household.

3.2.5 Socio-economic Characteristics

Newar is the predominant group in Nangkhel as most of them are migrants of Bhaktapur. This consists of 95 percentage of the population and the rest is Chhetris. The village is more or less a homogenous community. However, each group is further divided into various castes. Suwal, Duwal, Kasula, Byanju, Sukabhatu, Shyamaju are the main castes of Newar where as Deuja and Khadka belong to Chhetri group. Hinduism is the main religion here.

Bhaktapur including Golmadhi is a Newari settlement, one of the major ethnic groups of Nepal. They are divided into 94 different castes. Most of the people follow Hindu religion followed by Buddhist and Muslim.

The primary occupation of both the communities is agriculture. Some are involved in business, teaching, carpentry, masonry and services. There are 3 brick kilns operating in Nangkhel alone.

3.2.6 Natural Hazards in the past

Kathmandu Valley lies at high seismic prone zone. Since both the communities are located on the valley, they are always at earthquake risk. Both the communities had heard a lot about the 1934 Nepal-Bihar earthquake and its impacts. Most of the houses were damaged and collapsed in Golmadhi. The effect was more severe in this locality as compared to Nangkhel as the area was densely populated.

The communities had experience of 1988 Udaypur earthquake and all had felt the vibration. Golmadhi was the most affected area in Bhaktapur. About 25% of the houses suffered cracks including minor one, 4 % were damaged and1 % collapsed killing 2 people. Nangkhel was not very much affected by this earthquake. However, it had experienced three fires in the past in 2040, 2055 and 2063 but of small scale. Other hazards are not a serious problem in the valley.



3.2.7 Indigenous Knowledge in Community

Technological Aspects

In General, traditional house in the Kathmandu Valley is a two to four storey unit set among others in rows along a street. Usually each house has two bays separated by a centre spine wall set parallel to the front and back walls. The skeletal structure is covered with a tile roof pitched at an angle of about 35 degrees. Ceilings are low - 1.80 to 2.20 m.

Elements such as doors, windows, pillars and lintels were made of timber and incorporated structurally into brick masonry walls. These timbers are covered with ornate carvings that disguise with beauty their vital structural roles.

Load bearing elements of the ceilings and roofs were made of much heavier timbers than strictly required, because the artisans were not technically equipped to measure exact needs and stresses.

Ceilings: The flooring joists span bays of 2.20 to 2.80 m and their flat sections (10 × 7.5 cm) rest on wall plates. The distances between these joists are 10 to 15 cm in order to allow a sub-flooring of flat brick which is finished with 10 to 15 cm of clay or, in exceptional cases, clay tiles.

Roofs: The purlin/rafter construction employed is characterized by a broad roof overhang of about 1.20 m supported by struts. The laying of the rafters is similar to the laying of the roof joists described above. The internal structural support of the roof is designed in such a way as to keep the roof space free from obstructing elements. Rafters are covered with a layer of split timber or bamboo that carries a 10-15 cm layer of clay. Small "jhingati" roof tiles are then pressed into the wet clay.

The aim has throughout been to preserve as much of the original substance and cultural importance as possible. The structural condition of most of the buildings called for a comprehensive revision. Many buildings had thus to be partly or even completely dismantled. The task of reconstructing the buildings in exactly their previous form entailed an overwhelming amount of paper work and documentation.



It became obvious at this stage that, in order to avoid the structural damage resulting from the use of traditional methods, certain innovations would have to be introduced. Emphasis was therefore laid on a whole range of measures which will keep future maintenance down to the minimum and at the same time ensure that the buildings last for a considerable period. These innovations include better roofing, stronger foundations; moisture barriers and efficient timber treatment against rot, fungi and insects. Special attention was paid to the roofing as the most vulnerable factor. The rafters were covered with planking, and double tar felting applied in hot bitumen. This was then covered with a layer of mud treated with herbicide in order to prevent plants from sprouting on it. And lastly, the traditional "jhingati" roof tiles were pressed into the mud after being treated with a coating of silicon syltrete. The result is highly decorative waterproof roofing. Such comprehensive restoration is carried out only on buildings of historic importance.

3.2.8 IK status

A) *IK to be discarded*

Heavy Roofs*:* The roofs of the traditional buildings made by indigenous knowledge are made heavy by providing about 150 to 300 mm thick layer of soil and then heavy ceramic tiles were put over it. They think that by putting heavy load over the building makes the building more stable and also the wind do not topple the roof. But the area is not very prone to wind rather it is very much sever to earthquake so the method they are using for roofing is not suitable for the buildings as it increase the overall mass of the building resulting in the increased seismic force. The soil put above the roof also cause grass and other plants to grow over it and make the roof porous and unpleasant. The ceramic tiles that have been used were also very heavy and not tied properly with the soil so it can easily be damaged heavily during earthquake.

Row Housing: Indigenous people of Kathmandu valley have a concept that the houses built adjoining to its sides are stronger as they support each other during earthquake. So, most of the traditional houses are built adjoining to each other as row housing. But during past earthquakes, the adjoining houses were more destroyed than an isolated house due to hammering and pounding effects.

Lowest Storey: The ground floor or the basement is the most uncared part of the whole building as this part is unfit for human habitation. This part is affected by dampness. Here, the windows are very small and less ventilated. Much care is not given to this storey even during the construction of the building. The walls in

this storey may decay and distorted due to excessive dampness. During earthquake, this storey is most vulnerable as it bears the heavy pressure of other storeys.



Heavy roof



Row houses



Lowest storey

B) *IK to be strengthened*

Strengthening of Walls: The traditional buildings in Kathmandu are made up of thick and heavy walls and this increases the total mass of the house. Also there is absence of vertical posts in the walls. So to strengthen the walls some vertical posts in the corners of the walls may be placed, making the frame complete, it also strengthens the performance of the whole building.

Strengthening of Bricks: The main load bearing element in the traditional building is the walls, which is compose of brick elements. The bricks are made up of the mud and the strength of the brick depends upon the quality of mud by which it is made. In the traditional buildings the bricks used are of inferior quality which easily decay lowering the overall strength of the building. So the bricks should be strengthened to elongate its effective life.

C) *IK to be replicated*

House plan: The plan of traditional houses are generally rectangular, some are even square, which is very good from the earthquake safety point of view. The ratio of length to breadth is generally less than 2.



Height: The height of traditional buildings is generally three and half story. The ratio of height to breadth of house is less than or equal to 2.

Wall thickness: Its thickness is maximum at the ground floor, 45 centimeters. Thickness decreases with succeeding upper floors. As the horizontal thrust at the ground level develops highest at the time of earthquake in a building the greater thickness reduces the shear failure at that time.

Mud mortar: Generally in all structures mud is used as mortar in between bricks, Mud is very weak in strength as compared to the strength of brick and timber. In case of greater thrust the mud mortar cracks and helps to displace wall thus absorbing the thrust. This causes partial collapse preventing total collapse of the building.

Use of traditional materials: It has an additional benefit that even in case of total collapse most of the materials are reusable where as in case of concrete it is not possible. In case of the damage to the building, partial repair can be done.

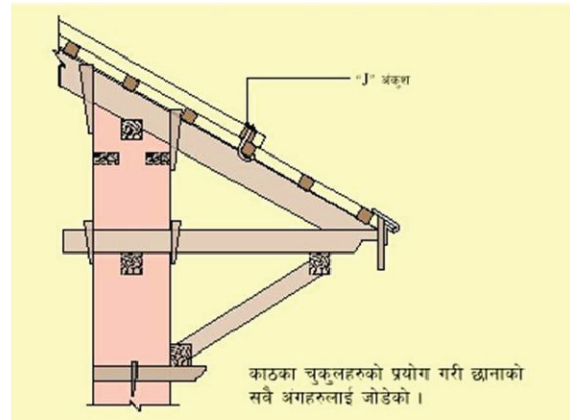
Timber Joints: One of the best things that have been done in the traditional buildings is the use of different types of joints in timber columns and beam framing system. The iron nails were never used in those buildings instead different types of timber joints (Dove tail, Mortise and Tenon joint etc.) are used which made the joints more flexible and intact during the earthquake.

Wooden elements: Traditional houses have many timber components like beams, joists, lintels, beautifully carved doors, windows and pillars. The wooden members tie the brick walls making them work as single unit. It prevents the distortion or displacement of walls in case of earthquake. The flexibility of wooden members can absorbs some external forces by bending itself and comes to its original shape after the force is released. It helps from breaking the wall. Even in case of breaking, the timber components prevent from total collapse, i.e. partial collapse takes place.

Different types of “Chukuls” are used to restrict the controlled movement of the timber members. Which prevent the main walls of the building from sudden fall down during earthquakes.



Timber Joints



Wooden elements

Timber Bands: Use of timber bands above and below the window makes the building intact and prevents behaving the elements as individual members. It tied up all the main walls and made strong during lateral movement.



Mr. Bishnu Bhakta Kusi, Ward No 7 Bhaktapur

"I am a carpenter by profession. Previously the Shilpakars used to do the wooden works but I got into it due to my interest in the profession. I do the wooden works related to houses and temples. It's been around 22 years that I have been involved in the process. I was involved in around 10-15 old houses and more than 100 new houses. While building traditional houses we use different types of joints in timber columns and beam frames. The iron nails were never used in the old buildings instead different types of timer joints are used. This makes the joints more flexible, they just twist and turn but hardly break during earthquakes. Wooden bands are placed in the corner and the wooden elements are connected to each other by chukuls (wooden pegs). I usually place Duchu in the door (double chaukos) which will make it even stronger"



Mr. Ganga Sagar Sukbhatu (local farmer), Nangkhel VDC, Ward No. 2

Both are connected by placing a special type of soil mixture called Dachapa (luscious soil) if it is not available then they just take the sub soil mix it with pango soil. Karnes kept in between making it water resistant
Vajra – brick paste, painted from outside
Dachi Appa- soil taken from 8-9 inches below the surface, soil mixed and molded and kept for 3-4 days by turning it over
Base 3-4 feet, then wall 30 inches to 2 ft up to minimum of 14 inches, the thickness of the wall goes on decreasing by 4 inches per floor.

3.2.9 Key findings

This study has shown that, many earthquake resisting elements present in the traditional buildings, sometimes many in one building and sometimes some in another. The buildings made by using indigenous knowledge are very much safe for earthquake loads also but the vulnerability has increased due to lack of repair.
On the basis of the above mentioned traditional technology we can say that our ancestors have learned a lot about the earthquake safety construction techniques although they did not know the complex calculation of modern earthquake safety designs. They had learned from their own experiences.
Many modern technologies has been developed in the recent years, the modern structures can be designed on the basis of relevant theories. But there are no such theoretical calculations available to design the traditional buildings but what is accepted and what can be speedily implemented by a community is more important than what is theoretically possible.
Furthermore social norms and values have been changed. We have introduced new construction materials and techniques. We started the use of modern construction materials like concrete and steel. There is a Moral/Ethical question, if our forefathers gave us the buildings as they are, why should we change it by using steel?

There are many more questions waiting to be answered, can we answer everything ourselves. If we cannot answer all of them now, let's answer at least some of them. There is a need to do further investment in study.

However, still we lack the systematic study on seismic resistance of our traditional/monumental buildings. There is a burning need to study those structures and know in detail about our traditional wisdom. Develop systematic methodology for assessment of seismic vulnerability of such buildings.

Develop strategies for seismic strengthening of such structures. What are the possible intervention options. What kind of materials we can use. What should be the approach for repair.

To address the situation, a systematic survey and study of historical buildings of the entire Himalayan region is to be carried out for understanding the building technology, material, evolution process, diversification in the region. Also to explore earthquake-resistant features in historical buildings and to develop methodology to preserve/revive, modify/adapt the earthquake-resistant technology in present context.

So, it can be concluded that, Nepal in general and the Kathmandu Valley in particular are very susceptible to earthquake. The vernacular house is made of clay, brick, timber and stone, which are very weak. The past earthquakes have proved that it can withstand in general, up to magnitude of 6 Richter scale. But magnitude above 6 is not uncommon. Keeping in view the importance of traditional architecture as it is a part of the living heritage, it is imperative to make it more earthquake resistant by applying, if possible, the new technology without interfering its original architecture. A conservation strategy for the indigenous earthquake-resistant technology should be developed to prevent the indigenous knowledge of the region.

3.2.10 Economic practices

One of the noticeable traditional economic practices some of which still exist in both the communities today is Guthi. Guthi is basically an economic institution or a system created by philanthropists with religious or philanthropic motives for the performance of any regular or religious ceremony, functions or festivals related with any monument or deity; or the construction, maintenance or operation of temples, ponds, rest houses, wells, roadside shelters, water spouts etc. To perpetually run the Guthi, the creators used to donate some property either in cash or kind, mostly in the form of cultivated land. There are private as well as public Guthis. Public Guthis are regulated by the government. Private Guthis are prevalent especially in Newar communities and are of various types and controlled



by the headman. There were altogether 10-12 Guthis based on different castes. Some are related to death rites, some to perform religious functions and some for the construction, maintenance and operations of philanthropic works.
Relatives and neighbors are not only the source of social help but also provide economic support as per their capacity in recovery period to rebuild the house with no interest or on the nominal interest rates.

Savings, Loans and Insurances

There were no such practices of insurance for disasters in the community. There are no such formal loan and savings in the community. It was kind of exchange system. Although there were certain associations of farmers which provide certain amount of money as loans, but the people was comfortable with the earlier system. There were two Cooperative organizations recently established in the community having members in the range of 70-72.

3.2.11 Social Practices

The village community has always been close knit and characterized by a strong inter-relationships and mutual support systems, many which are reinforced through the caste system. Both the communities being homogenous in character, mutual help, community sharing in such social networking and social structure was found to be very strong.
In 1988 earthquake in Golmadhi, neighbors were the first to rescue the three survivals through the window from the collapsed building and provide food, accommodation and moral support after the disaster.



Mr. Tulsi Bhakta Khowuju, Ward No. 7, Golmadhi

"During the 1988 earthquake one side of the wall of my house collapsed. My family was safe because we were sleeping on the other half. I was so helpless at that time because we were not economically sound, we didn't have any storage of food or money for disasters. At that time our neighbors helped us a lot. They gave us food to eat, helped us in our works in relocating our belongings. The only thing on my mind that time was to rebuild my house and start a normal life again, for that I needed money so I worked for others for the money and managed some amount from my relatives as a loan from them. My neighbors helped me through my bad time"

Nangkhel also had been exemplary community in the event of the fire where the whole community gathered and helped in such a way that they were able to put off the fire before the fire brigade came.

Guthi is not only an economic institution but a means of social networking as well. It helps to maintain social unity, social relation and encourage people for carrying out collective works. In fact, they are very strong cohesive factors uniting several segments of society. The temples and rest houses run by the Guthis were the venue for socio-religious functions including marriages, initiation ceremonies and other kinds of social feasting, in times of peace. In times of calamities these venues provide excellent rescue and relief sites. Thus the Guthis were useful both during peace and disaster. However, Guthi system is disappearing due to migration, inter caste marriage, new modern life style brought by the advancement in science and technology.

Various religious groups popularly known as 'Bhajan Mandali' are being emerged now these days where Guthi system is broken or absent in the communities for performing religious activities such as prayers, worships, temple construction. The function of such group is quite similar to that of Guthi. One such mandali exists in Nangkhel in addition to few Guthis. Apart from the Bhajan



Mandali, other groups like youth clubs, farmers' groups, and mothers group are also very common in the community.

3.2.12 Cultural and religious practices

Puja, Jatra

While building a new house, people perform certain Puja (religious ceremony) with a belief that it will make the house stronger, resilient to any disasters. The house worship is usually done during the foundation laying (Jag rakhne); and during that Puja they put small artifact made of tortoise shell underneath the foundation stone with a belief of making the jag as stronger as the shell of the tortoise.

There was a belief that whenever there is earthquake the female member of the family presses the floor by her thumb saying Diga Diga (Stop Stop in Newari), which the earthquake will stop. Similarly during earthquakes one has to embrace the main pillar saying "mine mine" and the earthquake will stop. Both the beliefs imply staying calm, quite and composed when one is facing the situation.

3.3 Constructing SWOT Matrix and Key Findings

i. Strengths

The following factors can be taken as strong points contributing to better seismic resistance.

- Presence of earthquake resistance elements in the building (small length to breath ratio, symmetrically located small openings, low floor height and less number of storey
- Presence of open spaces in urban fabric
- Presence of Guthis as a strong economic and social system
- Mutual support system in the neighborhood and community

ii. Weaknesses

The factors that make a building more vulnerable to seismic forces are

- Building related- low strength construction materials, inferior foundation, no provision of DPC
- Partial transfer of Knowledge and technology
- Inadequate theoretical knowledge



- Requirement of large spaces for wall
- Changes in built forms (village morphology and traditional structures)
- False perceptions and beliefs about earthquake

iii. Opportunities

- Strengthening of Guthi system
- Adoption and adaptation of earthquake resistance technology and elements in modern structures
- Mobilization of community and neighborhood in rescue and relief during disaster
- Realization of threats of IK and practices
- Conservation and Maintenance of open spaces
- Awareness raising to clarify false perceptions and beliefs about earthquake

iv. Threats

- Replacement of Traditional structures with modern construction
- Disintegration of Guthi system
- Scarcity of local materials and skills
- Changes in occupational structure
- Changes in social and economic structure through caste mobility
- Changes in land use and ownership

3.4 Conclusions

The Study, especially the field surveys and the focused group discussion, confirmed again that:

1. There is several sound and comprehensive practices of building construction in Nepal that are based on the physical, ecological, climatic, social, ethnic, and economic realities as well as on religious beliefs. Thus a "building is not only a compilation of bricks and stones", but a social element that reflects the cultural life of a community. The practice of building construction grows from the realities and likings of a community.



2. There are many positive elements in the traditional building construction practices and ways of materials usage that contribute to the stability of the buildings to withstand the vagaries of nature including earthquakes. Our ancestors learned to a certain extent how to live with nature.
3. However, several negative elements have also been identified with respect to earthquake resistance of the traditional buildings both in terms of the materials and the process of constructions. Several myths prevail in the local practices of construction. It is believed that the genesis of the myths is due to the changing socio-economic conditions and exogenous influence resulting in gradual obliteration of god practices.
4. There is virtually no effort to test the existing practices, both positive and negative one, scientifically. It is necessary to combine traditional local knowledge with scientific knowledge for filtrating what works and which myths should be discarded. It is necessary also to develop model for integrating local knowledge with scientific knowledge.
5. Therefore, researches should be carried out to test the technical and social validity of the traditional knowledge of construction not only for rejecting those methods that are not appropriate scientifically, but also to enhance wider proliferation of the positive elements of the construction technologies and the ways of doing this.

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Chapter 4

Indigenous Knowledge on Coastal Hazards in Sri Lanka

4.1 An overview of cultural beliefs and practices regarding coastal hazards in Sri Lanka

Sri Lanka has rich culture and it has a recorded history of more than 2000 years, and an archeological history of thousands of years. Sri Lanka's historical findings, historical records, social systems and beliefs, food and medicine patterns, environmental conservation systems and ancient water management systems reveal an existence of a well improved civilization for many thousands of years. There are written records of community knowledge on facing different natural hazards such as tidal waves, droughts, floods, epidemics in Sri Lankan history. Among those, there are records of a disastrous tidal wave that hit to the Island as well. The indigenous knowledge in Sri Lankan society is interlinked with technology, religion and mythology[1].

Prof. Arjuna de Zoyza explains that "The Indigenous knowledge in Sri Lanka is more restricted to a particular group of people or to a particular geographical area, while the traditional knowledge is more general". As M. Asoka T De Silva explains, tradition contains beliefs, customs and knowledge handed down through generations. It has specific features in a given culture, but is also a partner with other neighboring cultures[2]. Pandula Endagama explains, traditional knowledge is something referred to as "Indigenous Knowledge", "local Knowledge', 'Folk knowledge' and even as 'Past Knowledge'. This knowledge is in a way indigenous and local when it relates to a particular locality. It can be folks

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[1] Prof. Herath, Department of Sociology, University of Peradeniya, Sri Lanka- based on the personnel teleconference on the IK on coastal hazards on August 6th, 2008.

[2] De Silva, Asoka, "National Policy on Traditional Knowledge", unpublished policy recommendation paper.



in character when it reflects the features and practices of a particular community. It is also past knowledge because it flows from generation to generation[3]

4.1.2 Beliefs and practices

According to a myth, during the time of king Kelanitissa (circa 158 B C), a tidal wave hit either the present Kelaniya or the kingdom of Kalyani in the Deep South. The cause of the tidal wave was belief to be due to the injustice done by the king by placing the pious monk in a boiling oil pot. The damage caused by this tidal wave is recorded in the Thupavamsa and the Saddharmalankaraya and suggested that the gods in their anger were intent on destroying both the king and his kingdom. At the time Kelaniya city was seven 'gavuwa[4]' from the sea, (i.e. 28 miles), and the sea flooded all that extent short of one guava, i.e. one mile. This included all the small islets save 13 ports, tanks, anicuts, fields etc. stated in Thupavamsa. Saddarmalankara says one hundred thousand harbors, 970 fishing villages and 470 divers' villages, in short 11/12 of the entire island. Mannar escaped, Katupity-Madampe port also was saved. Thupavansa says that the sea rose and flooded the king's city. Rajavaliya says that, king Kelanitissa and his elephant were also drowned. There are no records of details of rehabilitation and reconstruction work undertaken by the successors of the king and ministers. However, if this incident happened in the Panama Pattu (Deep South) during the time of King Saddhatissa, it could be surmised that this area was flourishing with a population indicating that houses had been re-built and people settled.

Besides the written records, there are certain beliefs shared by the common people. Eye witness accounts of animal behaviour, especially how both wild and domesticated animals, including elephants, showed restlessness and began a hasty retreat from the potential disaster zone long before the catastrophic tsunami waves struck their habitats. Following the 2004 tsunami disaster observations made by several people have been recorded on the unusual behavior of different domestic pets (unusual sounds and restlessness) in Galle and Matara, unusual sounds and movements by eagles and sea gulls (muhudu lihiniya) in Yala sanctuary, unusual number of snakes gathering around a bridge in Baticaloa. The negligible number of animal deaths that occurred in the Yala National Park provides sufficient evidence

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[3] Endagama, Pandula, Traditional Knowledge, IUCN workshop for the development of a national strategy for incorporating traditional knowledge into development practices, Oct 2002, Kandalama, Sri Lanka, 2002.

[4] The ancient unit to measure length.



to prove that the animals sensed the danger before and escaped from it well before it actually struck the coast. Farmers in the South Western dry zone of the island consider the early nesting of the weaver birds in September as a sign of early rains appearing during the North East monsoon, but a severe drought to follow during the rest of the same monsoon period. Elderly village informants in Sri Lanka disclosed that the high frequency of 'black crows' nests' with a solitary chick in each seen in September was considered as possible sign of an impending severe drought. Conversely, the appearance of two or four chicks in black crows' nests is taken as an indicator of timely and abundant rain, and hence securing successful crops during the season to come. The appearance of swallows flying very low in late September or early October is considered a promising sign of very heavy rains in the offing. For the farmers, more swallows appearing means more rain and their non-appearance at least by mid-October is considered a sign of an impending drought in the coming season[5].

There is evidence about certain people sensing or dreaming about an impending disaster in Sri Lanka. The story from Panama village is a good example. "Few days before 2004 tsunami disaster, a villager was explaining that he saw a dream about huge tidal waves coming and destroying the country. In this dream he was told that the villagers should boil milk and make offerings to please the gods to save their village. The villagers believe in this kind of rituals and offerings and therefore, they carried out the rituals as told in the dream According to these villagers their village escaped the gigantic waves as a result of the traditional rituals and offerings to please the dieties[6]. There are traditional rituals attached to religious beliefs in the 'Panampaththu' area. The Paththini Shrine in Panama, Aluth Bandara shrine in Ambanpitiya, Murugan Shrines in Okanda and in Panama are examples. These gods in the Buddhist and Hindu sub cultures are respected and worshipped. The villagers conduct a ritual called 'Ankeliya' annually to please these Gods. In return, the villagers believe that these Gods will protect the villagers from any disastrous event. Scientists argue that the most fundamental reason why Panama escaped the tsunami waves was the fact that the villages refrained from damaging the sand dunes.

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[5] Tennakoon, M.U.A., "perceptions and Adjustments to disasters", the conference on early disaster warning and mitigation in coastal systems conducted in Beruwala on 19-20th January, 2007, The center for Endogenous Research and Development, Sri Lanka,pp34-45.

[6] Amarasinghe, Ranjith and Niroshana Peiris, Tsunami (Sinhala publication), Sri Lanka Environment Journalists Federationa and Green Education Center publication (Rs.300/-), 2004 pp 61 (number of pages 184)



There is another historical record of a tidal wave similar to a tsunami in 1883AD. The local news paper named 'Lanka Observer' on August 28, 1883 records about back-warding sea water for few minutes in Galle, Kalutara and Baticaloa. The same news mentions further that a similar type of event has happened in 1881, after an earth quake[7]. The traditional folklore has many stories about the natural hazards and the strategies that the communities used to cope with those disasters. Apart from the written historical notes on different natural hazards that occurred in Sri Lanka in general, and in its coastal areas in particular, there is a wealth of unwritten indigenous knowledge that existed, practiced and time tested for thousands of years. The indigenous knowledge of the communities on coastal hazards can be categorized into two types: -

- The indigenous knowledge based on technology
- The indigenous knowledge based on belief systems

4.1.3 Indigenous Knowledge for coastal hazard reduction

Based on the existing literature and the peer group discussions, the indigenous knowledge can be summarized under the sub categories of economic systems, technology, social systems and religious and belief systems. The below table presents the existing indigenous knowledge (IK) which can be used as disaster mitigation measures in coastal hazards; coastal erosion, tidal waves, wind surge, tsunami and cyclones.

4.1.4 Strength and Weakness of Indigenous Knowledge

Table 4.1: strengths/ relevance or married

[7] Amarasinghe, Ranjith and Niroshana Peiris, Tsunami (Sinhala publication), Sri Lanka Environment Journalists Federation and Green Education Center publication (Rs.300/-), 2004. This has ratified by Arthur C. Clerk by his book-'The Reefs of Taprobane' in 1957.

IK	Strengths/relevance	Weaknesses
Planting and protecting different species of Mangroves (kadol, katu ikiliya, manda, Kirala, beriya[8])	Reduce wave heights, protect the coast from erosion, reduces the current hinder water movements and attenuate wave heights, absorb substantial wave energy.	This mangrove area is also sometimes susceptible to erosion due to enhanced wave and tidal movement during certain times of the year, if the growth is not that wide.
Other Strand vegetation – Pandanus ordortissimus (Wetakeya and Dunukeya)	When associated with a seashore, improves slope, stability and consolidates sediment and reduces wave energy, protect the shoreline from erosion, withstand the impact of high energy waves and inundation by salt water, additional income by firewood, light timber for subsistence, (livelihood related) Provide habitat for fauna, insects to support the adjacent agriculture, Good landscape.	Almost 30% of the coastal communities are poor; therefore, though they have an idea of the better housing constructions, they do not have adequate resources to do so.
Natural sand dunes – Yala some areas and Panama	A natural barrier/ protection to resist tidal waves, wind surge and even tsunami.	The sand mining has been a threat to the sand dunes, therefore unless the community's awareness and involvement is increased and consolidated; it is difficult to protect sand dunes.
In building construction- use strong mud blocks for house construction, The house level is higher than the land	Reduce the impacts of the tidal waves. Protects the houses from flooding.	Cannot resist to tsunami, cyclones.
The religious place is built on a higher place than the village – easy access to all communities	One objective is to convey the respect, but also it has been the common place for public gathering in an emergency. A place for spiritual support and a place for relief in a common hazard/ disaster	In the case of cyclones, some of these types of religious places were also affected.
Boats – the traditional boats	Good for fishing in the lagoons. Built of using local materials.	Not suitable for deep sea fishing. Not resistant for tidal waves and cyclones.
The traditional methods of	Can be used during the tidal wave season (Varakan). A livelihood and	Yield could be less.

8 Vernacular names

fishing such as 'ja kotuwa[9]' 'karak gediya', karak gesima'	food security measure. Sustainable way of fishing, because the younger fish generation is protected.	
Traditional food preservation methods[10]	Drying fish (to be used during the off season or for selling) , drying vegetables, Jack fruit and jack fruit seeds preservation[11], preserving some fruits in honey, preserving salted fish as 'jadi[12]',	Most of the methods are time consuming.
IK in livestock husbandry[13]- Group responsibility of fencing and protecting crops, control of pests/ diseases by using non chemical methods, manures as fertilizers	Ownership for every partner, utilization & management of livestock collectively through a system of communal management and the conflicts related to animal husbandry was resolved by the leader – 'gamarala'. Environmental and health friendly methods.	-
IK in chena cultivation[14]- collectively decide on the area and crops for cultivation, use mixture of crops, huge trees are kept intact, use non chemical	Sustainable and efficient use of land and forest. Use of rain water for harvesting, where there is lack of water as a resource. Pollution by chemicals does not exist. Group spirit improved and conflict resolution was in built in the social systems. Reduce waste of crops and preparedness for hazards such as	When it is practiced without application of traditional knowledge, the chena cultivation can lead to deforestation and soil erosion

[9] The local languages. The explanations are given in the field survey.
[10] This is another main area for study- based on the discussions with Prof. Hemanthi Ranasinghe, Environmental Scientist, Director for the Indigenous Knowledge Center, Sri Jayawardenapura University, Sri Lanka, on August 6th 2008.
[11] Jack fruit is called as the 'rice tree' ('bath gasa' in local language), because it is a commonly used alternative for main food in Sri Lanka. There are evidence that people used preserved Jack fruit and seeds as main food during the drought season.
[12] Local name for preserved and salted fish – Sri Kantha, Burnard, Traditional Fishing systems (in Sinhala), Colombo, 2004.
[13] Widanapathirana, A, "Issues in sustaining IK in agriculture: learning from the past for future planning", ", proceedings of the first national symposium on the IK and sustainable development, Colombo, March 19-20, 1994, pp23-35
[14]Widanapathirana, A, "Issues in sustaining IK in agriculture: learning from the past for future planning", proceedings of the first national symposium on the IK and sustainable development, Colombo, March 19-20, 1994, pp23-35

methods, storage in 'Bissa[15]',	drought and floods by food storage method.	
IK in fish farming[16]- time period for fish catching, methods for fishing, distribution are decided collectively	Proportionate distribution of the yield, reducing the risks of facing hazards by preventing fishing during certain period of times, breeding of fish is encourage on sustainable basis, strengthened social linkages and reduce conflicts/ disputes among the communities.	Do not match with the higher demand for fish in the modern society.

4.1.5 Indigenous Knowledge for Coastal Hazard Early Warning

The communities followed many methods that served as disaster early warning systems in regard to different hazards.

Table 4.2: Indigenous knowledge on early warnings

Coastal hazard	IK in early warnings
Drought (the professional mentioned, though drought is not particularly a coastal hazard, the occurrence and the impact of droughts is common in the coastal areas as well[17])	Birds and Animal behaviors Swallows flying low Crows- one chick per nests in many crow nests[18] Reptiles –gathering, and coming out of their hiding places
	Appearance of heavy foliage very lower to the earth in the mornings- a sign of a drought[19]
	Change of the wind patterns and the humidity in the air

[15] A traditional crop storage system- A huge cup shaped storage basket is made using mud and timber, few feet above the ground level. This is well protected from rain by having a roof and well protected from pests by mixing with a powder prepared out of neem leaves and neem seeds.

[16] Widanapathirana, A, , "Issues in sustaining IK in agriculture: learning from the past for future planning", proceedings of the first national symposium on the IK and sustainable development, Colombo, March 19-20, 1994, pp23-35

[17] Based on the livelihoods surveys and related discussions by the communities along the coastal belt, Mr. Vishvalingam explained during the interviews on July 6th, 2008.

Tidal waves	The snakes gathering around the bridges in Baticaloa- has identified as an earlier warning of a disaster[20] (not identified as a sign of tsunami, because that knowledge did not exist)
Tidal waves	Unusual noises made by eagles and seagulls and their movement towards the land side[21] - a sign of tidal waves or a storm
A storm, a tidal wave (observed before tsunami, but the community never expected a tsunami)	Unusual behavior (restlessness and continuous barking / mewing) of the house pets such as dogs, cats – a warning about a natural disaster[22].
	Unusual crowing of crows, chirping of squirrels- in some areas it is considered as sign of a disaster.
Storm and sea surge	Changes in the wind patterns and the direction.[23]
Unprecedented natural hazard- related to the most common disasters in the area (coastal line- a storm/cyclone or tidal waves)	Unusual changes in certain plants Flowering of tala tree[24], excessive bearing of fruit in certain plants, sudden bearing of fruit or flowering in certain plants – such as orange varieties, wood apple.
Tsunami/ huge waves	The sea water retreating. [25]

18

19 Interview on August 6th, 2008 with Prof. Arjuna de Zoyza at the Open University, Nawala, Sri Lanka.

20 The Field officers, Oxfam Baticaloa office, Sri Lanka.

21 Uditha Hettige, Natural Scientists, Yala Safari Hotel, experience before 2004 Tsunami disaster

22 This has been observed in Galle and Matara before tsunami disaster, but no one attempted to understand about a huge tidal wave or tsunami.

23 Interview on August 6th, 2008 with Prof. Arjuna de Zoyza at the Open University, Nawala, Sri Lanka.

24 Scientific name is 'coripha umbraculifera'. This plant flowers with a very beautiful huge flowering as a fountain, when it is closer to die.

4.1.6 Indigenous Knowledge for response to coastal disasters

Existing indigenous knowledge on response during coastal disasters is summarized below in Table 4.3.

Table 4.3: During disaster IK in Coastal communities

IK during and after disasters-social practices	Remarks
The collective efforts in relief and rescue- social system of supporting each other	Culturally the Sri Lankan society has a system of supporting the community in a disaster, or in a grief. This is interlinked with the religious beliefs, in which the communities believe it as a good 'karma'. On the other hand this has been in practice as a responsibility and a value system which has come down through ages.
The religious institution and the assistance in and after a disaster[26]	The Buddhist civilization in Sri Lanka comprises of a self sufficient concept characterized by of the reservoir, Buddhist Stupa, village and the religious temple- 'vevai dagabai gamai pansalai'. The religious leader has been considered as one of the community leaders within the locality and at the national level as the advisors to the state leaders. The religious institutional system has been maintained as a spiritual support mechanism to generate resilience to mental distress.
The traditional healing systems (yantra manthra) and traditional	The traditional healing systems and rituals have a scientific base for the mental illnesses, trauma and phobia. In these healing systems, the traditional healers lead the person to think of the illness and change the particular persons thinking to feel as if he/she

[25] A case from Balapitiya – an old fisherman has educated others saying that they should run, when he saw the sea waves going backwards, because he has heard a folklore as it is a sign of a disaster, Amarasinghe, Ranjith and Niroshana Peiris, Tsunami (Sinhala publication), Sri Lanka Environment Journalists Federation and Green Education Center publication (Rs.300/-), 2004.

[26] Tsunami and Sinhala Monks (Tsunami saha sinhala snga parapura), Buddhist Center's publication, 2005



dancing and rituals[27].	has healed from the mental illness. This system can be identified as a traditional psychotherapy for many mental problems. The traditional fishing communities use many yanthra manthra and traditional rituals that are not specifically recorded in literature.
Traditional Ceremonies for protection of the community & yield.	'Mutti mangallaya'-The 'pot ceremony' this is an indigenous ritual that is performed by the farmers who are living in the inland and alone the coastal lines in order to please the local Gods and Goddesses and deities whom people believe can influence the communities well being[28].

4.1.7. Key findings

Post tsunami observations have shown that a green belt could be effective in protecting the coastal belt under certain circumstances. These circumstances include the appropriateness of the mix or composition of plants and the intensity of the vegetation belt to withstand soil erosion as well as to dissipate wind and wave energy. Various studies also show that mangrove forests and other coastal vegetation of certain density can reduce wave energy considerably and protect the coast from erosion, as well as effectively prevent coastal sand dune movement during strong winds[29]. For example, fishermen in the northern part of Meegamuwa estuary (Negombo lagoon) located on the western coast of Sri Lanka plant mangroves (Kadol) for generations, to protect their homestead against erosion. Mangroves are also planted by these fishermen to obtain twigs and branches to construct 'brush parks', a traditional fishing method in wide use among them.

[27] Dissanayake, Mudiyanse, "Yanthra Manthra for Physical and Mental healing" (Sinhala publication), S Godage Publications, Colombo, 2005, PP198, price 350/-, "Kohomba Yak Kankariya & Society"(Kohomba Yak KAnkariya saha samajaya), Sinhala publication, Godage Publication, Colombo 1989.

[28] Herath, H.M.D.R, "traditional rituals and resource management practices in the North Central province of Sri Lanka: sociological aspects of Mutti Mangallaya", proceedings of the first national symposium on the IK and sustainable development, Colombo, March 19-20, 1994, pp73-78

[29] Amarasinghe, Mala D, Proceedings of the conference on early disaster warning and mitigation in coastal systems conducted in Beruwala on 19-20th January, 2007, The center for Endogenous Research and Development, Sri Lanka. Pp 49-56



Natural Barriers - Galle



Natural Barriers - Unawatuna

It has been recognized that the artificial structures close to the sea front that obstruct or help to funnel the gush of water from storm waves, could enhance the impact of a devastating storm. In contrast, it was observed that the natural as well as of simulated artificial coral beds in mitigating coastal disasters. Observations on the wave energy dissipation capabilities of natural coral reefs or similar structural barriers have shown that their capacity in performing this function is related to porosity, flexibility and the occurrence of fractures. Fractures in specific coral systems are said to absorb an enormous amount of wave energy due to the increase in the surface area, hence surface free energy is absorbed from the waves[30]. At the places where there was a considerable extent of mangroves, for example, areas around Rekawa lagoon on the south western coast of Sri Lanka, at Medilla and Kahandamodara have experienced a relatively low impact in the hinterland that is shielded by mangrove and associated vegetation. In contrast, areas like Wella Ode, where coconut palms occupied the hinterland, of the waves have inundated an area extending 500m inland and have caused relatively high damage to lives and property.

Eye witness accounts of animal behavior, especially how both wild and domesticated animals, including elephants, showed restlessness and began a hasty retreat from the potential disaster zone long before the catastrophic tsunami waves struck their habitats. This shows the type of providence afforded by nature to these animals. Following the 2004 tsunami disaster observations made by several people have been recorded on the unusual behavior of different domestic pets (unusual

[30]De Silva, M.Asoka T and Arjuna De Zoysa (Ed), Proceedings of the conference on early disaster warning and mitigation in coastal systems conducted in Beruwala on 19-20th January, 2007, The center for Endogenous Research and Development, Sri Lanka.



sounds and restlessness) in Galle and Matara, unusual sounds and movements by eagles and sea gulls (muhudu lihiniya) in Yala sanctuary, unusual number of snakes gathering around a bridge in Baticaloa. The negligible number of animal deaths that occurred in the Yala National Park provides sufficient evidence to prove that the animals sensed the danger before and escaped from it well before it actually struck the coast. Farmers in the South Western dry zone of the island consider the early nesting of the weaver birds in September as a sign of early rains appearing during the North East monsoon, but a severe drought to follow during the rest of the same monsoon period. Elderly village informants in Sri Lanka disclosed that the high frequency of 'black crows' nests' with a solitary chick in each seen in September was considered as possible sign of an impending severe drought. Conversely, the appearance of two or four chicks in black crows' nests is taken as an indicator of timely and abundant rain, and hence securing successful crops during the season to come.

The appearance of swallows flying very low in late September or early October is considered a promising sign of very heavy rains in the offing. For the farmers, more swallows appearing means more rain and their non-appearance at least by mid-October is considered a sign of an impending drought in the coming season[31].

There is evidence about certain people sensing about an impending disaster in Sri Lanka[32]. While scientists and technologists have set sights on evolving modern techniques on early warning of natural hazards, it needs to be recognized that notwithstanding the conjectural nature of the theoretical basis of the traditional wisdom, indigenous knowledge is known to have been used by isolated communities in the South Asian region to foresee and detect natural warning messages that have helped them to mitigate losses to life and property[33].

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[31] Tennakoon, M.U.A., "Perceptions and Adjustments to disasters", the conference on early disaster warning and mitigation in coastal systems conducted in Beruwala on 19-20th January, 2007, The center for Endogenous Research and Development, Sri Lanka,pp34-45.

[32] Amarasinghe, Ranjith and Niroshana Peiris, Tsunami (Sinhala publication), Sri Lanka Environment Journalists Federation and Green Education Center publication (Rs.300/-), 2004 pp 61 (number of pages 184)

[33] De Silva, M.Asoka T and Arjuna De Zoysa (Ed), Proceedings of the conference on early disaster warning and mitigation in coastal systems conducted in Beruwala on 19-20th January, 2007, The center for Endogenous Research and Development, Sri Lanka, p2.





Rehabilitation of Dunes

4.1.8. Economic and social practices & systems

During the off season it is quite common for many poor coastal families trying to get loans for subsistence[34]. In order to prepare for any unforeseen catastrophe, many coastal families buy jewelry as an important asset for them mortgage for loans during the off season. There is a socio economic set up within the coastal communities to have a powerful money lender in the village, who will lend money without any hesitation but at a higher interest rate. Still, this has been a social system that had been there, as an alternative for the lacuna of proper bank loans facilities for the poor coastal communities, specially the fishing and agriculture communities.

The fishing communities have been practicing a system of sharing available resources and labor for collective economic gains in many parts of the coastal areas. This system is called 'aththam' in local language. Few community members- in most cases the extended family members – pool their available resources, so that they will secure better and assured gains than they would obtain individually. In this system, one person provides a boat while few others provide their labor for fishing. The fishing yield is also divided proportionately among the contributors.

[34] Based on the unpublished reports: "Integrated programme for the rehabilitation of the fishery sector in the tsunami affected districts of Hambantota, Ampara, and Batocaloa", FAO and NACA, 2005, National Disaster Preparedness Plan, World Vision Sri Lanka, 2007, Research on Community Capacity Building programming in Disaster Preparedness Strategies in Sri Lanka, Institute for Participatory Interaction in Development, 2007.



"This has been a common system used since ancient times in Sri Lanka, not only in the fishing sector, but also in the other economic sectors including agriculture[35]".

Mutti mangallaya- This ceremony has a long history as a cultural festival in ancient communities. This ritual has two stages. Firstly, when the tank is filled with water the communities in the locality get together offer a 'vow' (panduru bendima) promising that they would conduct a 'pot ceremony' once the cultivation has been successfully completed and the yields are harvested. The dates for the ceremony are also decided with the participation of the villagers. This has been a way of managing the time and resources and also ensuring mutual commitment to a common cause in an effective and a sustainable way. The communities are well aware about the available resources- especially water and plan their cultivations accordingly. As agreed at the beginning of the cultivations, the pot ceremony - 'mutti mangallaya'- is conducted when the crop is harvested and processed. The costs and resources for this ritual are collected from each and every family in the village as donations. This is a good example of the social capital that existed in the traditional villages in Sri Lanka. The same social capital which existed and the common understanding of the available food for the villagers are very important in case of a disaster. Associated with the preparation for the ceremony, the villagers used to renovate their water reservoirs in a very participatory manner, which can be identified as a disaster mitigation and preparedness measure in ancient communities, inland and along the coastal areas as well. The concept of God or the spiritual powers as explained by Herath, "Have dual characters- it regulates society in the process of resource management and provides community consciousness of the self reliant, less expensive system"[36].

4.2. Field Study on Indigenous Knowledge for Coastal Risk Reduction

An isolated coastal hazard prone Beliwalagoda hamlet, Medagama H.N. Division, in Hambantota District in Southern Sri Lanka with 67 families was chosen for the field study. The Beliwalgoda Village is isolated because there is no external support to the villagers except the support from the Grama Niladhari, who

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[35] Based on the personnel interviews with Prof. Hemanthi Ranasinghe at the University of Sri Jayawadenepura on August 6th 2008.

[36] Herath, H.M.D.R, "Traditional rituals and resource management practices in the North Central province of Sri Lanka: sociological aspects of Mutti Mangallaya", proceedings of the first national symposium on the IK and sustainable development, Colombo, March 19-20, 1994, pp73-78

is the village level government officer in the government administrative structure; there is no Police post or a Police station, a Post office or a temple in this village. The education level of the majority is GCE Ordinary Level. The villagers do not have either a cemetery or a community hall. There was a foot path from village to the mangroves (Kadolana -a specific kind of trees) closer to the sea earlier. There is no evidence of any newly designed disaster preparedness plans, or mock drills being conducted for risk assessments and identification of evacuation routes being carried out in this particular area.

The types of the main economic activities in this village are fishing in the lagoon, fishing in the sea, home gardening, chena cultivation and paddy cultivation. Apart from those, small business (Boutiques), brick making, animal husbandry (Poultry / cattle), rope making (Coir), sewing at home, waged employment in the government sector, small business at weekly fair, timber sawing and foreign employment are other economic activities. The women in this community are largely engaged in food processing, food conservation and home gardening.

Type of houses in this locality can be categorized as completed permanent houses, incomplete permanent houses and temporary houses. According to the data gathered during the field observation and the discussions, this village can be identified as a poor village, which is vulnerable to the negative impacts of disasters.

Indigenous knowledge have equipped the community with the foresight that strong indigenous trees such as Khomba (Neem – margosa), mango, and jack etc in the home gardens provide sufficient protection from strong winds. Therefore the community has replanted and protected such species of trees. Since 1980 the Department of Forestry started the conservation of the mangroves to protect the coast from erosion, tidal waves and wind surges.

After the tsunami the Forest Department resumed the conservation of the mangroves in a participatory manner .People from neighboring villages as well as a few NGOs such as NARA and Action Aid had an opportunity to join in that effort in 2006, 2007 and the first quarter of 2008. Almost 95% of the scheduled activities of the mangrove conservation program have been accomplished and at present the mangrove stands as a dense and beautiful forest cover against the wave actions of the sea.

In the event of a disaster situation CBO Leaders and the Informal community leaders take spontaneous initiatives to avert or minimize risks to life and property. As experienced in the past Tsunami situation, at the first indication of a disaster leaders rushed in to evacuate children, aged, the sick persons and women in the first instance and place them in the safety of the temple in Netolpitiya (1 Km distance) using cycles, motor cycles and three wheelers

4.2.1. Methodology

***Secondary data*:**
The data for the village's socio-economic profile were collected (such as number of houses, number of families, religious and ethnic composition, population by age, education and employment statistics by sex, number of differently-abled by sex, houses by types, availability of infrastructure facilities such as electricity, drinking water, toilets, maternity clinics, health centers etc).

Primary data collection using Participatory techniques:
Social mapping to identify House by types, families fishing in the sea / lagoon, families by other occupations boutiques, other buildings, roads, foot paths, cultivations, , coastal area, lagoon, Kadolana (mangrove) area, trees etc; Historical profile developed through Focus Group Discussions (FGDs) and Semi Structured Interviews (SSI) to arrive at history of community, wealth and wellbeing ranking; Semi structured Interviews (SSI) / Focus Group Discussions (FGDs) to know the profile of natural hazards and disasters that have affected the community (a structured format was used) and indigenous Knowledge on economic practices, social systems and social practices , religious activities and belief systems, and the nature and extent of resilience of the community to hazards were probed by the focus group discussions.
The coastal community in this village identified flood, tidal waves, tsunami and drought as the principal disasters they have undergone during the last 30 years.

4.2.2 Key findings

The communities used different mitigation and preparedness methods derived from IK to reduce risks of hazards as explained below.



Strong winds /Cyclones: Traditional knowledge have equipped the community with the foresight that strong indigenous trees such as Khomba (Neem – margosa), mango, and jack etc in the home gardens provide sufficient protection from strong winds. Therefore the community has replanted and protected such species of trees.

Coastal flood: During the rainy seasons usually in the monsoon months of November-December in most of the years floods occur due to the over flowing of the tanks in and around the village and also due to breach of / damage to the tank bunds. According to the elders who participated in the study the community does not have traditional solutions to floods. But in order to minimize the risk of flood damage channels and water courses were regularly desilted and cleaned of debris. This usually helped the flow of excess water within a shorter time during rainy seasons.

Drought: Taking sufficient measures to ensure food security during periods of droughts is perhaps the only strategy the community has adopted to wade off the vagaries of protracted droughts. Obviously the community did not have any strategies to prevent a drought. Among the steps they usually took to ensure food security, drying and storage of food items like Jack fruits, Bread fruits etc and maintaining a security stock of paddy in traditional bins called " vee bissa" (made of cane or bamboo tats and plastered with earth), take prominence.

Tidal waves/Tsunami: The 2004 tsunami was a new experience for the community. Since none in the community had undergone a tsunami even of smaller proportions ever in their living memory, however the community is well conscious of the protection that mangroves offer from tidal waves, and they have always respected the existence and conservation of mangrove forests abutting the sea. Being experienced fishermen the sea-going members of the community are aware of the precautions they should take with regard to maneuvering fishing boats during times of storms and high waves, when entering a boat/canoe in to the sea that they sail following the direction of the wind flow. In this practice the boat/canoe must be ridden against the wind direction and if they sail in the other direction the boat/canoe will be pushed speedily in to the deep sea area and the fishermen will lose control of the boat.

Risk Reduction in Fishing

Most risky period for the fishing in the lagoon and the sea is from May to September in every year. This is called 'Varakan' (tidal waves). In the biggest

constraint to fishing is strong winds driven by the monsoon. Due to this wind situation fishermen who work in the lagoon find it is difficult to lay the fishing net properly in the water, often the nets surfacing. The elder fisherman who lived in the past used to overcome this difficulty by hanging few pieces of rocks (granite) of the size of $2^{II}x2^{II}$ to the fishing net and laying the net in to the water in the lagoon. This has helped them to harvest a considerable fish yield even during varakan period. This traditional technology has been improved now by manufacturing lead weights for the same purpose today.



Religious profile of indigenous practice -Kirinda



Mangroves-Natural Protection

4.2.4. Indigenous Early Warning Systems (EWS) for Sea State Forecasting

Fishermen who venture out into the sea employ a very sophisticated system of observation of the behavior of the waves. Traditional knowledge has equipped them with hindsight on the most suitable point in the wave behavior to venture out. Members of the community who are experienced sea fishermen stated at the Focus Group Discussions that usually they observe 7 waves of considerable crest height that land on the beach. The 8^{th} wave is usually soft and smooth and the 9^{th} wave will be very soft and very smooth. They know that just after the 9^{th} wave is the most suitable time for entering the boats / canoes in to the sea (diyamba). Also when returning from sea to beach the boats laden with fish the same observation and practice must be followed at a point of the sea 50 meters from the coast. If this traditional knowledge is not followed, the result will be destruction and threat to the lives of fishermen

Traditional knowledge has taught the fishermen that they should observe the direction of wind flow. By about 9'0 clock in the night a big star begins to be visible in the sky. Usually this big star slowly appears to move towards the land side. This star helps the fishermen to reach the coast in the night.
Experienced fishermen provided interesting information on traditional depth-sounding techniques in order to veer away from submerged rocks in the sea bed. According to the traditional knowledge an oar should be of 6 ½ feet height, using of jack timber. Two or three fishermen go to the sea by a canoe with the oar and one of them immerse one end of the oar in to the sea and place an ear to the other end of the oar. If he hears a sound similar "SILI", it indicates that the area is free of rocks. If the sound was "PATA - PATA" the area is considered as a rocky area. After this testing the fishermen always avoid that area for fishing to reduce any risks.

4.2.5 Economic practices including savings, insurance, conservation etc for reducing the risks of disasters

The rich category and the 40% - 50% of the average category maintain saving accounts at commercial banks. Also more the than 80% of the women in those Categories possess gold jewellery (chains, bangles, rings etc) worth of Rs. 15,000 /- to Rs. 30, 000/- for pawing at a risk situation. Mostly they pawn the gold items during the varakan season due to insufficient income received from fishing.

A number of Community Based Organizations (CBO) are functioning in the village of Beliwalagoda, which operate savings schemes. Some of the villagers have savings on the savings schemes affiliated with those societies. A few community members are been covered within the Fisheries Pension Scheme and the Farmers Pension Scheme.

4.2.6 Social practices (Mutual help, Community Sharing etc)

In the event of a disaster situation CBO Leaders and the Informal community leaders take spontaneous initiatives to avert or minimize risks to life and property. As experienced in the past Tsunami situation, at the first indication of a disaster leaders rushed in to evacuate children, aged, the sick persons and women in the first instance and place them in the safety of the temple in Netolpitiya (1 Km distance) using cycles, motor cycles and three wheelers. The non availability of a



cemetery in the Beliwalagoda Community is identified as a problem. Also the average extent of a home plot of a majority of the families is 1/4 acre (60%) which made it impossible to bury the dead in their own lands. In this situation most of the families (80%) were helpless owing to non-availability of a cemetery and the inadequate space in their own home plots. The wealthy families with the guidance of the village leaders provided assistance to the poor in cases of deaths in order to conduct the funerals. In the situations like this the families coming from the above average and average category in this village discussed and took an action to conduct the funerals at the cemetery in Tangalla covering the funeral cost by them, (This process has been carried out for 5-6 families in the past).The other collective activity on mutual help is Shramadana function. The villagers (at least one member from each family) participated Shramadana which was held in 2006, 2007 and 2008 for replanting the Mangrove forest. Further, the houses destroyed in the years 1949.1965 and 1969 by floods have been rebuilt by the villagers through Shramadana. Traditionally the members of the community voluntarily participate in all religious and cultural events like pirith chanting or alms-giving, of fellow members of the community, whether invited or not. In the event of any unexpected incident or risk situation, some families borrow money from their peers in the village. The giver does not consider this as a loan, but rather as mutual help.

4.2.7 Perceptions of the communities on IK

All of the Community groups interviewed stated that existing norms, values, and practices in economic, social, cultural and religious need to be strengthened. The younger fishermen should be trained on how to repair the fishing nets on their own at home. Further the community members participated in the study revealed the aspects to be strengthened; maintain honesty among villagers, find additional income sources, avoid cheating others, be active, improve savings further, make the younger generation aware on the importance and value of the traditional norms, values and fallacy of some of the aspects related to the modern society, improve sharing benefits of the societies especially in varakan situation. The Community suggested replicating all those in other areas in the country.

Women groups in the village mentioned:

"We must respect the Buddha and Gods. They help us to achieve our dreams."

"We believe in pirith chanting, alms giving for monks and Gods, astrology and charms. We cannot live nor do our day to day work in the risky environment without unseen powers of them."



4.3 Constructing SWOT Matrix and Key Findings

In this case, for constructing SWOT matrix and to arrive at the key findings, a participatory approach was followed. It was factorized in SSI and FGD. Major highlights are summarized below:

There are different discussions around the strength of indigenous knowledge. "If we consider traditional value systems, I think there are three principal strengths that are associated with those value systems. First of all there is a certain emphasis on security, something that is sadly lacking in our own civilization and culture. The security came from certain basic relationships, the family, the temple or the church as the case may be, certain relationships which were central to the life of the community at that time."

Further he explained, "Secondly, there was a sense of balance. There was a perceptive equilibrium that was achieved. I think that is equally important. Man's conquest of nature was always tempered by certain moderation, a certain restrain in the exploitation of the resources of nature"

And he says that the third hallmark in a traditional value system is that of contentment. People were generally content with their lot in life. There was not an overweening desire to extend oneself, to expand the horizons of achievement in such a manner as to stultify one's own initiatives[37].

The IK has three main aspects – materials, operations or practices, and institutional systems responsible for the implementation of the knowledge[38]. The materials which are connected with the IK the traditional seeds, medicines and pesticides collected from the plants and animals, the tools used in livelihood such as 'kemana' and 'karakgediya' in fishing. The practices are characterized by the manner in which the various activities are conducted. The traditional, ceremonies, rituals and praying for mental preparedness and healing, the traditional environmental friendly farming, fishing systems and conservation mechanisms,

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37 The text of a lecture given by Prof. G.L. Pieris at the National Museum in Colombo organized by the Cultural Survival Trust on behalf of the National Committee for the International Year of the World's Indigenous People. http://vedda.org/glpieris.htm accessed on Aug 2nd.

38 Widanapathirana, A, "Issues in sustaining IK in agriculture: learning from the past for future planning", proceedings of the first national symposium on the IK and sustainable development, Colombo, March 19-20, 1994, pp23-35

social relationships can be highlighted as examples. The socially inbuilt institutional arrangement existing in many traditional communities ensures the transferring knowledge from generation to generation, continuity and provision of facilities for the adoption of the knowledge. These systems also serve as a system of conflict resolution in the society.

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Chapter 5

Indigenous knowledge of the vulnerable communities living in the drought prone areas of Rajasthan, India

5.1 Introduction

A preliminary review of literature on droughts and famine in India suggests that the interaction between drought shocks and the economy are complex rather than direct and straight forward. Famine and drought are an inter-woven global endemic natural phenomenon occurring in different parts of the world at different times of varied intensity. The basic difference lies in the degree of mortality, geographic scope, chronological duration, intensity or severity. The concept of drought varies from place to place depending upon normal climatic conditions, available water resources, agricultural practices and the various socio-economic activities in a region. It is difficult to define drought in terms of natural conditions of rainfall, temperature and soil, because drought is a human conception, that is, inseparably tied to the mode of making a living and to the cultural level of societies. Any comprehensive definition of drought must take into account the complexity of socio-cultural, economic and political organisations of societies and the consequent variations in the effects of lack of adequate rainfall in the local settling. Also, a drought is necessarily to be perceived in terms of the needs of a given community. Drought is frequently defined according to disciplinary perspective.

The perception of drought also varies across states and across social and economic section of the society. People do not view drought as a simple, unified way. Their perception of drought is complex and responses often unpredictable. Hence the expected impact of drought and the responses also are different. In order to understand the diversity of coping strategies, it is necessary to explore the social,

political and institutional factors that provide contexts for these individual perceptions.

The coping strategies or adaptations to drought vary across different agro-climatic regions and are evolved on the long inter generation indigenous knowledge of the society/ people in those regions. The indigenous knowledge on coping strategies or adaptations to drought generally relates to mitigation or vulnerability reduction of the direct and indirect impacts of drought. However, most literature on drought discusses the role of state in providing relief rather than the coping strategies of people or community.

Till now state intervention in managing disaster risks from climatic hazards has focused on reducing exposure and vulnerability of socio-economic systems to drought, cyclone, storm, flood, etc. through prevention, mitigation and preparedness actions, with an aim to reduce loss of lives, shelter, infrastructure and livelihoods. However, the results would have been better if the risk pattern could be anticipated and human experiences dealing with these risks could be drawn to build resilience. This would include: (a) analysis of coping mechanism to extreme climate event, (b) utilising the lead time provided by seasonal climate forecasts to undertake proactive coping strategies, and (c) taking long-term mitigation measures and evolving and operationalising adaptation strategies.

Indigenous knowledge played significant role in saving human and livestock population from climatic disasters. This knowledge evolved after a long intergenerational experience and was carried forward through oral and pictorial traditions. It varied according to agro-climatic conditions and geography of the region. It is the variability in occurrence of rainfall over time and space and distribution of demand for water, which forced human beings to innovate methods to deal with adverse conditions and make available fresh water round the year in desired quantity and quality. The crisis was not due to the lack of fresh water as such, but the availability of adequate quality water at the right place and time to meet basic needs. This study deals with the indigenous knowledge dealing with droughts in India and more specifically in Rajasthan, the most water scarce region of India.



5.2 Scope of The Study

This study is limited only to one of the climatic risk, namely drought, as experienced in India and more specially the Desert State Rajasthan. The objective of the study is to provide historical account of droughts and document the indigenous knowledge about the coping and adaptation strategies of people in India. A case study of a community vulnerable to drought in western Rajasthan is being conducted to show how traditionally society/community responded to climatic variability in Rajasthan.

Climate change is becoming the most important challenge for social development and human security of our time and become one of the highest priorities on national political agendas worldwide. The study addresses the question whether the past experience can help reducing societal vulnerability to drought and climate change and guide government to formulate better policy and interventions.

5.3 Methodology

The methodologies used for this study is as follows:

Literature review: Various published and unpublished literatures (traditional religious texts, books in local language and english, write-ups, published research papers) on Indigenous knowledge on drought and famine in India. Adaptations and coping strategies followed by people across India, especially in the arid and semi-arid regions as available in published text, oral history and research reports were documented.

5.4 Limitations

This study was carried out within a limited time period; therefore, it could have not captured all related literatures available. It is also a fact that limited literature is available on indigenous knowledge about adaptations and coping strategies followed/practiced by people in different parts of India. However a detailed bibliography is being compiled for future study.

5.5 History of Droughts and Indigenous Knowledge

Famine/drought is no new feature in the history of India. There are references to famine in the Buddhist *Jataka* stories and in other Indian epics. The traditions of the Jains give prominence to the terrible famine which occurred late in the fourth century B.C., towards the close of the period of King Chandra Gupta Maurya, which lasted for 12 years. We find reference to sever and prolonged



drought during the Ramayana period also. Famine/drought, in traditional literature, is being classified according to their intensity as follows: *annakal* (grain famine), *Jalakal* (scarcity of water), *Trinakal* (scarcity of fodder) and *Trikal* (scarcity of all, i.e. grain, water and fodder). The modern science has classified them as meteorological drought, hydrological drought, and agricultural drought.

The word `famine' has been defined as a condition of extreme general scarcity of food or want of food, hunger and starvation in a certain area or part of a country. While `drought' means dryness of the weather or climate or lack of rain or untimely rains leading to insufficiency of food, fodder and water. The Encyclopaedia Britannica gives a list of the great famines that scourged the world from the times of the Roman Empire till the end of the nineteenth century. Review of literature shows that famine has been gradually disappearing from the western world after the revolution in agriculture through HYV's crop technology and significant development in storing and transporting technology. Famines are gradually also disappearing in Asia with the help of external support and also high economic growth observed in Asian countries.

Occasional failure of rains and consequently of crops have been a known feature in India since time immemorial. Hymns invoking rain in the *Vedas*, namely *Riga* and *Atharva*, mention of excess of rain or drought damaging crops. In the time of Chandra Gupta Maurya a severe famine occurred in 293 B.C. in Bihar, which is said to have lasted for twelve long years. Drought occurs in all the Asian countries, of varying intensity and at different locations. These are mainly caused by variation in monsoon rains. Kautilya in the Arthashastra provides the best account of the history of famine relief measures in ancient India. In times of famine, according to him, the king should provide to the subject's seed and food obtainable from king's own stores, or from rich subjects, or from king's friends. He also recommends migration to sea shores or river banks or lakes, encouragement of agriculture, charging additional revenue or contributions from the rich, incentive to subjects to grow vegetables, roots and fruits where water was available and the hunting of wild beasts, birds or fish for food. We get more references to famines in the writings of medieval chroniclers. The earliest reference is to the famine of 1291, during the reign of Jalaluddin Khilji, severely affecting parts of Delhi and the Siwalik Hills. The first ruler to introduce vigorous famine relief measures in medieval India in a systematic way was Muhammed bin Tughlaq, who in 1343 distributed six months' supply of grains to the inhabitants of



Delhi, made grant from the treasury for farming and well digging and unsuccessfully attempted to introduce compulsory labour.

5.5.1 Traditional knowledge about Monsoon Prediction

Traditionally the role of state in the times of droughts and famines was very minimal. It was the community institutions with their long experience that have developed strategies to face droughts of different intensities and minimise the impact. Communities had oral tradition to pass on their experience from on generation to other particularly in the field of crop cultivation practices, storage of fodder, food and water harnessing techniques. These experiences did not find many places in written literature except the books coming out of respective regions. In Vedas water has got special mention at various places. In fact in *Vradh Sanhita* a chapter is on water resources and their social aspects including management of the resource. Since drought is a situation created by variability in occurrence of rain causing stress in availability of food, fodder and drinking water, it is important to understand this variability across time and space. The risk attached to this variability of rainfall affects human and livestock population and their vulnerability. Though understanding rain variability in short and long run is extremely difficult, yet ancient Indian population living in different agro-climatic regions did develop oral and written indicators to reasonably predict rainfall.

Based on the traditional knowledge and long generation experience about the cloud formation, lightning, wind direction, occurrence of rains in particular period of lunar calendar, the rain forecasters use to predict the reasonably exact nature of rainfall for the entire reason along with good and bad effects of rain (drought). The quantity of rainfall use to be determined with the help of a gauge whose diameter is one cubit.[1] The unit of measurement use to be *Adhaka/Angular*. Also the prospect of rainfall in a season is to be determined by the rainwater that falls for the first time in any asterism. In other words, it is the start of the initial rain which is pivot to the prospect of rainfall throughout the season or in the coming months.

Generally, astronomers in a town used to gather at a particular point on a given date and time to observe wind direction, intensity and other parameters to predict rainfall in a year and hence based on that the prospects of good or bad

[1] *Vradh Sanhita* , Chapter 23, page 245.

agricultural production.[2] There are well known Sutras given in ancient books to predict monsoon, and prospects of agriculture. Even in villages, it is a very common feature that farmer consults *Brahmana* about the monsoon in a year. The other practice is when the new lunar calendar is released in the month of March *Brahmana* announces about the good and bad features and events in the coming year including chances of drought or good rainfall.

Monsoon predictions are also made based on the nature, colour, direction of flow of clouds and lightning in the clouds. The prediction that a particular is likely to be a drought year, the nature of clouds are described as follows: "There would neither be prosperity nor rain in the land, should the clouds be rough and small, tossed about by the wind, have the shape of camels, crows, dead bodies, monkeys or other inauspicious creatures, and be silent".[3]

5.5.2 Traditional knowledge about crop prospects

The Traditional knowledge was also used to predict *Jamana*, i.e., agricultural crop prospects, mostly for rain-fed crops. The crop prospects prediction are generally based on the direction, type of clouds, wind direction on particular day and month. The related experience was compiled and put in the traditional religious texts and now also published in local languages. As a example, one of the *sutra* is as follows: "If the clouds rise in the east, there will be good crops; in the south-east, there will be outbreak of fires; in the south, crops will decay; in the south-west, only partial growth of crops; in the west, good rains; in the north-west, stormy and sporadic rain; in the north, very fine and full rain; and in the north-east, bumper crops. The same effects should be predicted of the wind also arising in the several directions."[4]

There are enough Sutras to predict origin of water based disasters, earthquake, erratic rain etc.[5] Numerous books published in local language across the country has compilation of the traditional sayings or proverbs and wisdom on rainfall variability, crops and cultivation practices under different rainfall

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2 Ibid. p. 250-53.
3 Ibid. p. 256.
4 Ibid. p. 257.
5 Ibid. p. 258-305.



conditions and expected outputs, etc.[6] The sayings in these books are orally recited by older persons in the villages and they act as guide in agricultural practices, particularly in the *kharif* season.

Traditionally there existed knowledge, based on past experience that used to be passed on orally to next generation, about the severity and extent of famines/drought in Rajasthan. Given the geographical and climatic condition of the state the people based on long generational experience by observations of certain natural phenomenon occurring before and after famine/ drought have arrived at a relationship between such phenomenon and the likelihood of the intensity of rainfall and drought. These natural phenomenons may be related to wind direction, cloud pattern, the positions of planets, behaviour of animals, birds and changes in plants etc. In order that future generations may benefit from this traditional knowledge or wisdom they have reduced these to certain traditional proverbs or verses so that they can be remembered easily and passed on to later generations. The best description of these is available in the *Braht Samhita* from chapter 21 to 42, covering all the aspects of rain water related aspects.

5.5.3 Adaptation to climatic variability

Change is inherent to the human context. Whether the need is catalysed by extreme events such as droughts, floods and economic collapse or more gradual process of change in environmental, technological and economic systems, human populations survive via adaptation. Strengthening the adaptive capacity of populations at all levels from the local to the global is, as a result, among the most important challenges facing development. The ability to adapt to local problems, such as droughts and floods often depends on systems and flows that connect to regional and global levels. Understanding this and addressing the inherent implications for migration, trade and other sensitive policy arenas is, perhaps, one of the most significant challenges facing society in the current and coming centuries.

While droughts and floods are inherent features of life in South Asia, they have been greatly exacerbated by human interventions that have changed both hydrologic systems and the impacts associated with extreme events. As a result,

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[6] For details see the popular book for north Indian population on rainfall, crop cultivation practices, etc. in "Ghagh-Bhadri ki Kahawante", published by Pandit Ramlagan Pandey, Shri Thakur Pustak Bhandar, Varanasi, 1999.



droughts have a fundamental impact on the economic viability of rural livelihood systems.[7] Adaptation is, perhaps, the single most important mechanism human society uses to respond to change and the impact that has on basic livelihood systems. Whatever the nature of the extreme event, i.e. drought or flood, livelihood systems must respond at multiple levels from the individual households to the supranational in order to remain viable. The ability to adapt to local problems, such as droughts and floods often depends on systems and flows that connect to regional and global levels.

Over centuries, Indians had learned to use their land-water-vegetation resources in an intelligent and sustainable manner. Due to seasonal nature of rains, Indians had developed numerous types of water harvesting and diverting systems to meet their needs round the year. They did not build huge wall across big rivers to dam them. They caught the huge amount of rainwater that fell in their own village before it disappeared into the river. Large parts of India are hills and mountains, arid and semi-arid plains, and humid and heavily flood-prone regions. Water needs for domestic and agriculture in their different regions needed carefully find-tuned systems of water supply, distribution and management. However, each type of structure had its limitations to meet water needs.

One of the major community interventions to cope and/or adapt to the climate variability and consequential agricultural risk was to harness rainwater by constructing different types of structures. The name and size of these structures vary across states but the basic purpose remains the same. These structures directly help in mitigating the impact of drought. If one looks into the history of these structures they have existed since Vedic times. In the southern states of India, about two tanks there is mention in the Ramayana, namely, the lake of Five Nymphs (*Panchaprara tataka*), associated with Madakarni or Satkarni, and the Pampasaras, the name of a tank in Huvimothadagalli taluk, Bellary district, on the Tungabhadra river. Further, there are references to irrigation tank practices in the early records of people of India, dating back to many centuries before the commencement of the Christian era. Many of the tanks found in southern India have been in existence for several generations; two in Chingelpet district are referred to in inscriptions of the 8th and 9th centuries (Harris, 1923). There is a system of tanks in Kattagari referred to in the inscriptions of 1096 AD. This system

[7] For details, see Moench & Dixit (ed.) 2004) "Adaptive Capacity and Livelihood Resilience", Institute for Social and Environmental Transition, Boulder, USA.

demonstrates the technique or practice of constructing tanks in a series at different levels of a watershed. In 1108 AD, a merchant named Dasi-Setti renovated and increased the size of a tank at Bhanvur.

In the Indo-Gangetic plains, though the climate follows the general pattern of South Asia the rivers flowing through the plains have usually large catchment, which includes the Himalayas. Snowmelt in these mountains makes the major river perennial. The topography also permits diversion of river flows to feed canal systems. In South India, by contrast, the rivers are mostly seasonal. There are no extensive plains and geology is not favourable for groundwater storage. The local topographic variations have been effectively exploited to impound rainfall in tanks, which are used for irrigation. There are an estimated 127000 tanks in the states of Andhra Pradesh, Karnataka and Tamil Nadu[8].



Low-cost mini-percolation tank

Various kings, merchants and communities were active in constructing tanks/rain water harnessing structures in different parts of India (Oppen & Rao, 1980). In few cases tanks were donated to temples as pious acts and for their upkeep. In south the irrigated agriculture increased by creation of these tanks in large number, interconnect, and as a series from top to down, i.e. overflow of top dam is received by next dam downstream. A system was developed within which irrigation facilities were constructed, maintained and regulated by the same organisational units that controlled cultivation processes as a whole.

8 A. Vaidyanathan (1985) "Water Control Institutions and Agriculture: A Comparative Perspective", Indian Economic Review, New Delhi, Vol. 20, No.1.



Although run off collection tanks exist in nearly every district of India, the density of tank irrigation varies considerable from district to district. In the semi-arid tropical region of India tanks are concentrated in South and Central India, i.e. in the coastal districts of Tamil Nadu and Andhra Pradesh, in South-central Karnataka, in Telengana and in East Vidarbha. In North India, there are two pockets which show a high density of tank irrigation, i.e. North-east Uttar Pradesh, in the area of the former kingdom of Oudh, and in Rajasthan, East of the Aravali mountain range. The tank sizes varies across states based on rainfall, geology and population density. Tanks are time tested structures to harness rain water.
Anil Agrawal and Sunita Narain (edt.) 1997 in the report entitled Dying Wisdom have documented the traditional water harvesting systems in the 15 agro-climatic regions of India. It is evident that how the indigenous knowledge was used to harness available water resources to cope with drought and other climatic conditions to meet the drinking water and irrigation needs. These can be better understood by going through the detailed discussion about Rajasthan experience.

5.5.4 Traditional technological options

Traditional technologies which saves water and energy and is being practiced in parts of the Rajasthan State is given in the below.

Traditional water Harnessing Practices

Traditional Technology	Where it is being used / where it has been invented	Basins, where the technology seems to be useful
Paar system	Paar is a common water harvesting practice in the western Rajasthan region. It is a common place where the rainwater flows from the agar (catchment) and in the process percolates into the sandy soil. In order to access the rajani pani (percolated water) kuis or beris are dug in the agor (storage area). Kuis or beris are normally 5 metres (m) to 12 m deep. The structure was constructed through traditional masonry technology. Normally six to ten of them are constructed in a paar. However depending on the size of the paar the numbers of kuis or beris are decided. There are paars in Jaisalmer district where the kuis are in operation. This is the most predominant form of rainwater harvesting in the region. Rainwater harvested through PAAR technique is known as Patali paani.	Outer Basin
Talab /	*Talabs a*re reservoirs. They may be natural or can be human-	Sabarmati Basin



Traditional Technology	Where it is being used / where it has been invented	Basins, where the technology seems to be useful
Bandhis	made, such the lakes in Udaipur. A reservoir area of less than five *bighas* is called a *talai*; a medium sized lake is called a *bandhi* or *talab*; bigger lakes are called *sagar* or *samand*. The *pokhariyan* serve irrigation and drinking purposes. When the water in these reservoirs dries up just a few days after the monsoon, the pond beds are cultivated with rice.	Any other basin
Saza Kuva	An open well with multiple owners (*saza* = partner), *saza kuva* is the most important source of irrigation in the Aravalli hills in Mewar, eastern Rajasthan. The soil dug out to make the well pit is used to construct a huge circular foundation or an elevated platform sloping away from the well. The first is built to accommodate the *rehat*, a traditional water lifting device; the sloping platform is for the *chada*, in which buffaloes are used to lift water. *Saza kuva* construction is generally taken up by a group of farmers with adjacent landholdings; a harva, a man with special skills in groundwater	Shekhawati, Sabi, Ruparail, Bananga
Johad	*Johads* are small earthen check dams that capture and conserve rainwater, improving percolation and groundwater recharge. Starting 1984, the last sixteen years have seen the revival of some 3000 *johads* spread across more than 650 villages in Alwar district, Rajasthan. This has resulted in a general rise of the groundwater level by almost 6 metres and a 33 percent increase in the forest cover in the area. Rivers that used to go dry immediately following the monsoon have now become perennial, such as the River Arvari, has come alive.	All Basins
Naada/ Bandha	*Naada/bandha* is found in the Mewar region. It is a stone check dam, constructed across a stream or gully, to capture monsoon runoff on a stretch of land. Submerged in water, the land becomes fertile as silt deposits on it and the soil retains substantial amounts of water	Sabarmati, Sukli, Mahi West Banas, Banas ,
Rapat	A rapat is a percolation tank, with a bund to impound rainwater flowing through a watershed and a waste weir to dispose of the surplus flow. If the height of the structure is small, the bund may be built of masonry, otherwise earth is used. Rajasthan rapats, being small, are all masonry structures. Rapats and percolation tanks do not directly irrigate land, but recharges well within a distance of 3-5 km downstream. Silting is a serious problem with small rapats and the estimated life of a rapat varies from 5 to 20 years	All Basins
Chandela	These tanks were constructed by stopping the flow of water	



Traditional Technology	Where it is being used / where it has been invented	Basins, where the technology seems to be useful
Tank	in rivulets flowing between hills by erecting massive earthen embankments, having width of 60m or more. These hills with long stretches of quartz reefs running underneath them, acted as natural ground water barrier helping to trap water between the ridges. The earthen embankments were supported on both sides with walls of coarse stones, forming a series of stone steps. These tanks are made up of lime and mortar and this is the reason why these tanks survived even after thousand years but the only problem, which these tanks are facing, is siltation of tank beds. Chandela tanks usually had a convex curvature somewhere in the middle of the embankment; many older and smaller tanks were constructed near the human settlement or near the slopes of a cluster of hills. These tanks served to satisfy the drinking water needs of villagers and cattle.	
Kunds/Kundis	A *kund* or *kundi* looks like an upturned cup nestling in a saucer. These structures harvest rainwater for drinking, and dot the sandier tracts of the Thar Desert in western Rajasthan. Essentially a circular underground well, *kunds* have a saucer-shaped catchment area that gently slopes towards the centre where the well is situated. A wire mesh across water-inlets prevents debris from falling into the well-pit. The sides of the well-pit are covered with (disinfectant) lime and ash. Most pits have a dome-shaped cover, or at least a lid, to protect the water. If need be, water can be drawn out with a bucket. The depth and diameter of *kunds* depend on their use (drinking, or domestic water requirements). They can be owned by only those with money to invest and land to construct it. Thus for the poor, large public *kunds* have to be built.	Outer basin, Luni basin
Kuis/Beris	Found in western Rajasthan, these are 10-12 m deep pits dug near tanks to collect the seepage. *Kuis* can also be used to harvest rainwater in areas with meagre rainfall. The mouth of the pit is usually made very narrow. This prevents the collected water from evaporating. The pit gets wider as it burrows underunder the ground, so that water can seep in into a large surface area. The openings of these entirely *kuchcha* (earthen) structures are generally covered with planks of wood, or put under lock and key. The water is used sparingly, as a last resource in crisis situations.	Outer basin, Luni basin
Baoris/Bers	*Baoris* or *bers* are community wells, found in Rajasthan, that are used mainly for drinking. Most of them are very old and were built by *banjaras* (mobile trading communities) for	Luni, Banas, Banganga, Gambhir

Traditional Technology	Where it is being used / where it has been invented	Basins, where the technology seems to be useful
	their drinking water needs. They can hold water for a long time because of almost negligible water evaporation.	
Jhalaras	*Jhalaras* were human-made tanks, found in Rajasthan, essentially meant for community use and for religious rites. Jhalars are ground water bodies which are built to ensure easy & regular supply of water to the surrounding areas. The jhalars are rectangular in shape with steps on three or even on all the four sides of the tank. The steps are built on a series of levels. The jhalaras collect subterranean seepage of a talab or a lake located up stream. The water from these jhalaras was not used for drinking but for only community bathing and religious rites. Jhodhpur city has eight jhalaras two of which are inside the town & six are found outside the city. The oldest jhalara is the Mahamandir jhalara which dates back to 1660 AD	Outer, Luni
Nadis	*Nadis* are village ponds, found near Jodhpur in Rajasthan. They are used for storing water from an adjoining natural catchment during the rainy season. The site is selected by the villagers based on an available natural catchments and its water yield potential. Water availability from nadi would range from two months to a year after the rains. They are dune areas range from 1.5 to 4.0 metres and those in sandy plains varied from 3 to 12 metres. The location of the nadi had a strong bearing on its storage capacity due to the related catchment and runoff characteristics.	Outer basin

5.6 Summary of Review of Literature

There are enough descriptions of what State did but less on what people did to cope with disasters. Famine had occurred all over India and the rulers of different kingdoms took various relief measures. But what lacks in the history is the account of community adaptation and coping strategies. The account on these aspects is indirectly derived from the practices of natural resource management, account of community institutions, their functions and other social descriptions. To summarize, review of literature on traditional/indigenous knowledge to cope with droughts and famines in India reveal the following:

a) People had deep knowledge about rainfall variability and this knowledge was preserved and transferred to next generations orally and in written *sutras* alien to common man.



b) Based on the indigenous knowledge rainfall and crop prospects used to be predicted every year to take measures to cope with variability and impact on livelihood.
c) Number of risk averting measures were taken to ensure (i) drinking water throughout the year, i.e. till at least up to the next monsoon, (ii) selecting crops, cropping patterns and cultivation practices for efficient utilisation of available rainwater, (iii) supplementary income from non-farm activities by maintaining size and composition of animals, diversification of occupation, plan – short and long terms – out migration with or without animals to support the household and to seek help from within and outside the community.
d) Organise community efforts in case of severe droughts. Use of social capital to cope with climatic variability, construction of community food storage, fodder and water storage, evident as a common feature in western Rajasthan. Sale of assets, borrowing from friends, relatives and moneylenders and migration are common coping strategies followed by people from all sections of the society.

5.6.1 Strength and Weakness of the Indigenous Knowledge

Historical review of literature on droughts/famines and the adaptations or coping strategies of Ruler class and the people at large shows that water being the basic necessity and its availability was uncertain over time and space, most intervention and activities were related to rainwater harnessing, storage and regulating the use pattern. People evolved, innovated technologies to construct rainwater harvesting structures suited to different agro-climatic conditions. Kings, business community, religious priests, etc, tried to provide financial, spiritual and other inputs to support construction activities to ensure sustainable drinking water supply. Drought also affects food availability and food production that are highly correlated to rainfall or water availability. The fluctuation in agricultural output in extreme case leading to agricultural drought was traditionally taken care by storage of grains and their distribution during stress period. Indigenous underground and above land storage structures was designed. Livestock is also affected by extreme climatic variation and there are enough evidences in the ancient texts on fodder storage, migration and people/community making special efforts to feed livestock during stress period. There were indigenous techniques of storing fodder for short run and long run (ranging from 3 to 10 years) without damage. There are



references to how the grazing practices use to change with varying rainfall and availability of fodder in common grazing lands.

The review also indicate that despite all such indigenous knowledge, in severe drought or consecutive droughts ranging between two to five years the traditional system could not provide water, food and fodder security. Added to it the lack of health facilities increased the loss in number of human and livestock even reached to lakhs. The significant limitation of the traditional technologies and indigenous knowledge is that it used to be mostly in oral form, transferred from one generation to the next and confined to few people. Hence, further development in technology did not take place fast enough to cope with new changes.

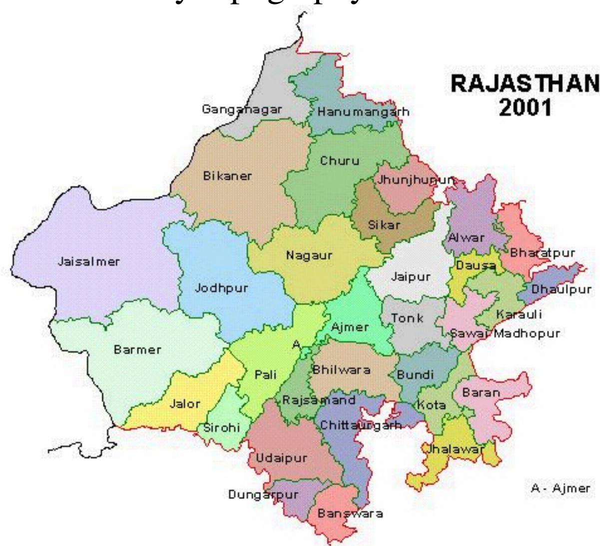
The systems based on indigenous knowledge could have even taken care of the increasing demand for natural resources and food but for the political instability prevailing across the country in the past. There were continuous fights for control over landmass, the invasions were from within and outside and the size of State use to be small with varying systems of rules and regulations. All this damaged the then existing structures, knowledge, skills and skilled populations. Creative work used to take place only in peaceful times and in a political regime of powerful and creative kings or rulers. Rulers used to motivate, protect and propagate the knowledge and innovations in a society. Historical texts are full of such incidents and descriptions. Structures, traditional knowledge and skills were most affected by outside invaders, namely, Mughals, Mongol's, British's etc., as they also tried to impose their respective culture and knowledge. This political instability with climatic variability took away the positive gains of indigenous knowledge to cope with droughts or natural disasters. The indigenous system got bigger jolt after the change in political scenario with democratic system prevailed in India, after Independence. Western science became the base for development doctrines and the traditional systems, even culture, was looked down. There was further neglect of indigenous knowledge in all walks of life.

Despite all that, the new literature on the subject positively indicates the strength of indigenous knowledge to deal with natural disasters. The need is to identify these strengths and weaknesses and build upon to evolve new strategies which are people and user friendly.

5.7 History of Droughts in Rajasthan

Rajasthan the largest State of India with a land area of 342 thousand Sq. Km. and population on 56.47 million of which 76.6 percent population is rural and 23.4% urban (Census 2001). It has only 1 percent water resources, 10.4% of total area and 5 percent of total population of entire country (GOI 2004). Sixty percent of the State area covering 40 percent of total districts falls within the great Indian Thar Desert. Administratively the State is divided into 32 districts and 241 tehsils.

For historical and geographical reasons, the state still classified as one of the socially and economically backward States. Recurrent droughts, poor resource base for economic development, highest per capita cost of development because of Arid and Semi-arid areas with low density of population, low level of literacy particularly among women, a very high rate of population growth and scarcity of water make the task of socio-economic development a formidable one as compared to many other States in the country. The climate of Rajasthan State varies from arid to sub-humid. To the west of Aravali range comprising of 11 districts covering roughly more than 50 percent area, the climate is characterised by low rainfall with erratic distribution, extremes of diurnal and annual temperatures, low humidity and high wind velocity. The climate is semi-arid to sub-humid in the east of the Aravali range comprising of 12districts, characterised by more or less the same extremes in temperatures by relatively lower wind velocity and high humidity with better rainfall. The remaining area falls in the south within the Aravali range with high rainfall and hilly topography with forest cover classified as tribal area.





Bavri (Step well)

The average rainfall of Rajasthan is 57.43 cm (2001) in the state and it varies significantly across different regions. The general trend of isohytes is from northwest to southeast. There is a very rapid and marked decrease in rainfall in the west of the Aravali range, making western Rajasthan the most arid part. The average annual rainfall in this part ranges from less than 10 cm in north-western part of Jaisalmer (lowest in the state), 20 to 30 cm in Ganganagar, Bikaner, Barmer regions, 30 to 40 cm in Nagaur, Jodhpur, Churu and Jalore regions and more than 40 cm in Sikar, Jhunjhunu and Pali regions and along the western fringes of the Aravali range. On the eastern side of the Aravali range, the rainfall ranges from 55 cm in Ajmer to 102 cm in Jhalawar. In plains, Banswara (92.0cm) and Jhalawar (95cm) districts receive the maximum annual rain. Mount Abu (Sirohi district) in the southwest, however, receives the highest rainfall in the state (163.8 cm). The yearly total rainfall is highly variable at different places all over the state and it is most erratic in the western half with frequent spells of drought, punctuated occasionally by heavy downpour in some years associated with the passing low pressure systems over the region.

The southwest monsoon, which has it's beginning in the last week of June in the eastern parts, may last till mid-September. Pre-monsoon showers begin towards the middle of June and post-monsoon rains occasionally occur in October. In the winter season also, there is sometimes, a little rainfall associated with the passing western distribution over the region. At most places, the highest normal monthly rainfall is during July and August. The number of rainy days during this period varies widely in different places, ranging from 10 in Jaisalmer to 40 in Jhalawar and 48 in Mount Abu. Rainfall during the rest of the period ranges from 2.1 cm at Jaisalmer to 7.2 cm at Jaipur, distributed over 2.5 to 6 rainy days[9].

These features had shaped the livelihood of population in the different regions of Rajasthan. The adaptation and coping strategies are very much similar across the state. People have adopted diverse occupation pattern to cope with fluctuating agricultural income. As the groundwater availability and its depth varies across the state. It is deeper and brackish in the western part of Rajasthan. There is a saying in Rajasthan "deeper the water wiser the person".

[9] For more details see Khan, Y (1998), "Climate and Dryland Ecology", IDS and Rawat Publication, Jaipur.

Drought is not an event it is a reality in the case of Rajasthan as since 1901(last 102 years) there has been 48 drought years of varied intensity. Also on further disaggregated analysis one finds that only 9 years out of 102 years when none of the districts were affected by drought. If we go below district i.e., village level, than the number of drought free years will be less than 9. It shows that every year some or other part of Rajasthan is affected by drought.

District wise intensity and frequency of drought in Rajasthan (1901-2002)

District	Intensity and frequency of Drought (percentage)				Normal or Good (%)
	Very Severe	Severe	Moderate	Light	
Western Region	26.0	26.0	23.9	23.9	54.9
Barmer	8.5	31.9	36.1	23.4	53.9
Jaisalmer	12.5	25.0	27.0	35.4	52.0
Bikaner	17.4	26.0	34.8	21.7	54.9
Sri Ganganagar	18.8	18.8	25.0	37.5	52.4
Churu	18.1	25.0	18.1	38.6	56.7
Nagaur	4.0	34.7	30.6	30.6	51.5
Jodhpur	9.0	29.0	29.0	32.7	46.0
Pali	13.4	23.0	36.5	26.9	48.0
Jalore	13.2	24.5	24.5	37.7	47.5
North-Eastern Region	25.5	17.0	23.4	34.0	53.9
Sikar	10.0	40.0	22.0	28.0	50.5
Jhunjhunu	18.7	31.2	25.0	25.0	52.9
Alwar	14.6	33.3	20.8	31.2	52.9
Jaipur	21.7	23.9	34.8	19.6	54.5
Ajmer	13.0	34.8	45.7	28.3	54.5
Tonk	20.9	25.6	23.3	34.9	54.0
Swai Madhopur	15.7	18.7	27.4	41.1	50.0
Bharatpur	20.0	28.9	24.4	26.7	55.4
Southern Region	23.3	27.9	20.9	27.9	57.8
Bhilwara	8.3	25.0	27.8	38.9	62.5
Chittorgarh	22.7	27.2	20.5	29.5	56.0
Udaipur	22.7	31.8	31.8	13.6	56.4
Sirohi	9.4	32.0	18.9	39.6	47.0
Banswara	23.4	29.8	27.7	19.1	53.9
Dungarpur	22.5	40.0	25.0	12.5	60.4
Bundi	14.9	34.0	27.7	23.4	53.9
Kota	17.4	34.8	23.9	23.9	54.4
Jhalawar	18.6	30.2	32.6	18.6	56.1
Rajasthan	20.8	20.8	31.3	27.1	52.9

Zone wise Intensity of Drought in Rajasthan (1901-2002)

Intensity of Drought	Number of Years			
	West Zone	North East Zone	South Zone	Rajasthan
Very Severe	12	12	10	10
Severe	12	8	12	10
Moderate	11	11	9	15
Light	11	16	12	13
Normal	56	55	59	54
Total	**102**	**102**	**102**	**102**

5.7.1 Traditional drought management strategies

Water has been harvested in India since antiquity. Evidence of this tradition can be found in ancient texts, inscriptions, local traditions and archaeological remains. A mere description of the known hydraulic structures spread throughout the country would require lot of time and pages. There is some evidence of advanced water harvesting systems even from pre-historic times. The Puranas, Itihasas (Ramayana and Mahabharata) and various Vedic, Buddhist and Jain texts contain several references to water, its importance in life, livelihood and management systems and structures, namely, canals, tanks, embankments, wells and large number of local names.[10] *Khadins*, tanks, *nadis* and *Johads* in Rajasthan, *bandharas* and *tals* in Maharashtra, *bundhis* in Madhya Pradesh and Uttar Pradesh, *ahass* and *pynes* in Bihar, *kuhls* in Himachal Pradesh, *ponds* in the Kandi belt of Jammu region, and *eris* in Tamil Nadu, *surangams* in Kerala, *kattas* in Karnataka are some of the ancient water harvesting, including, including water conveyance, structures still in use today. Traditional systems are specific response to ecology and culture in which they are evolved and satisfied certain local needs in an environment friendly manner. Traditional systems have benefited from collective human experience since time immemorial and in that lies their biggest strengthen. They are based on the sound principles of ecological conservation in contrast to environmental overuse of modern systems.

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[10] For more details, see five books on water and life, religion, culture, etc. published by Tarun Bharat Sangh drawing from Veda and other religious texts.


Nadi in a village


Community Tanka


Traditional rainwater harnessing structure in Thar Desert

The principle of water harvesting was to conserve rainwater where it falls according to local needs and geographical conditions. Traditional water harvesting systems have to meet domestic and irrigation needs of the people. Functionally, these systems have sustained communities through dry months and at times even stood the test of prolonged drought periods. But sometimes, when the rains failed for years together, small systems broke down. This created the need for big systems. But the balance between small and big structures was worked out carefully. Traditional systems used low cost, user-friendly techniques and were



easily kept in good operational conditions by local communities, i.e. no external support was required or no external dependence was created.

Historically, in Rajasthan people responded to droughts to minimize climatic risk and mitigate the impact by development of physical infrastructure, of various types, that were adapted to the natural cycle of drought and other extreme climatic events in a given region. The capacity of Rajasthan people is evident from their adaptive capacity in terms of the indigenous knowledge and the physical, social and cultural, and technological measures they took in the past to face the most adverse climatic and natural conditions existing in the Thar Desert of Rajasthan, to meet drinking water, food and fodder demand in scarcity conditions.

5.7.2 Drinking water management

Water is Life' and its realization takes place only when one come across water scarcity as prevailed in the Thar desert of Rajasthan. It can be understood also by the fact that when a guest arrives in a household in Thar Desert instead of serving water he is offered butter-milk or milk or only one glass of water that too blended with brackish water. Guest's demand for water makes the host uncomfortable, as he has to fetch potable water from long distance at heavy cost. The desert area receives low rainfall varying between 100 mm to 250 mm in a year, and 90 per cent of years some part or other is drought affected, i.e. quantum of rainfall is 25 per cent or more below the average rainfall. People walk miles to fetch drinking water and use each drop of it very carefully. Even in such adverse conditions, human and livestock could survive with the traditional rainwater harvesting technologies. Surface and subsurface water harnessing technology was evolved to quench the thirst. Even after the modern technological interventions, these traditional systems are still the most reliable source of drinking water in the region.

Thar society evolved cultural beliefs that ensured judicious use of the scarce resource of water and, over the centuries enabled it to keep competing pressures on its natural resource base within manageable limits, permitting survival in the desert terrain. The system not only supported the scattered settlement of rural population but also city like Jaisalmer, centre of trade route from Gulf countries to India. Ghadhsisar Lake is a living example of how, with very low rainfall, a lake in the middle of sand dunes could sustain life.


Ghadhsisar Lake in the Thar Desert (Jaisalmer)

The water harnessing structures used for supply of drinking water varies according to geological conditions, rainfall in the area, and type of settlement. In most parts of western Rajasthan, the desert area, there is a layer of gypsum at varying depth starting from Northwest to Southwest districts. Below the gypsum layer, the groundwater is deep and mostly brackish of varying intensity. Therefore, the traditional drinking water sources are designed to overcome these features. Rainwater is harnessed both on the surface and below surface depending upon the topography and demand for water. Rainwater trickling down in the earth is tapped at two places: firstly sub-surface water and secondly the groundwater. To avoid mixing of rainwater to brackish groundwater, small structures, namely *kuin* (shallow wells), about a depth of 45 to 55 feet, are dug to tap the sub-surface water before it percolates to the salty water table, to meet the need of few households or single household. The structure of *kuin* has a small opening at the top and size of cavity gradually increases with depth. It is mostly


Beri Renovated With Super Structure


Rain Water Harvesting Beri at Bhane Ka Gaon, Bikaner

above the gypsum layer so the water is of good quality and it is named as `*rejani*' water. The desert people have classified water into three categories; first is *palar pani*, i.e. rainwater falls on the surface of the earth and collected in different structures or flows in rivers, etc. The second is called *patal pani*, that is, subterranean water or groundwater. The third type of water is called *rejani pani*, which is the sub-surface water above the gypsum layer, much better than *patal pani* (mostly brackish) and mostly used for drinking purpose. There is special technique to construct a *kuin*, which will be able to collect this special *rejani* water. A *kuin* has a circumference of 6 to 8 ft. to a depth of 45 to 100 ft.

Rainwater harnessing by construction of different types of structures is very common across Rajasthan. These are constructed to harness the *palar* water for mostly drinking and other domestic use. The common names of these structures are *kund, kundi, tanka*, etc. These are individually and community owned and located within boundary of house, agricultural fields or in village common lands. These structures can meet only partial water demand of a household, but also serve as water storage tank when rainwater is exhausted. In case of shortage of water people transport water from distance and fill these structures to use for longer period.



Tanka in the front courtyard of a house.

The designs of these structures are based on their size and amount of rainfall in the area. Inside of these structures is lined in such a way that not a single drop of the water collected within is lost through seepage, and throughout the year the water remains clean and protected. The catchment area around these structures is

called *agor,* are made of specific size and are well maintained so that raindrops get collected into the structures and are also free of any pollution.

These structures are also constructed in agricultural fields. Given the large area of agricultural land in the desert region, the distance between villages and fields are quite large. Since to work on field's water is inevitable, small and big *kundis* are made at small intervals. *Kundis* can be both private and collective. Private *kundis* is made in front of houses, in the front courtyard (*angan*) and/or backyards. The collective *kundis* are made on common lands or usually between two villages. *Kundis* are made in sandy regions where the water table is deep and the ground water is salty. These are totally made of local material.



Earthen kund in an agricultural field

In the Desert Region whether a house is small or big, a permanent structure or not, the *kundi* will always be of a permanent structure. The villages are generally far-flung and moreover thinly populated. Therefore, it is not possible to have a centralised arrangement to distribute water to such widely dispersed settlements. That is why the society evolved a totally decentralized system of water work, based on their local needs and available rainfall. They also made *kunds* to collect rainwater, which falls on the roof, courtyard and the plains.

Kundi is also built in the middle of the field. These are either privately owned or community owned (if on common lands), for providing drinking water to farmers working on their field without fencing, mostly away from the village habitation and drinking water for travelers passing by the road.



Community Tanka in Shekhwati region of Rajasthan.



Rooftop water harvesting on the fort in Rajasthan.

The other structures are *tankas* (reservoirs). They are pretty much like *kunds* and *kundis*. The water collected in them comes from the roofs of houses instead of the courtyard. The size of *tanka* is in proportionate to the size of roof and also considering the family water requirement. The *tanka* is usually located in a room, a hall or courtyard and it is properly covered. To ensure its purity, no one goes on the rooftop wearing any footwear. Tanks are even made in uninhabited places, far from localities, villages, and hamlets and are basically for society. These are also meant for herdsmen and cowherds.


Tanka


Tanka in agricultural land

Besides these small structures, meeting the drinking water needs of individual household or few households there were structures to meet the water requirement of a village, large village, or number of villages or a town. Such structures were known as *bandh-bandha, taal-talai, johar-johari, nadi, talab, sarvar, sar, jheel, deibandh-jagah, dahari, khadeen, bhe*. All these water bodies have been filled by rainwater. In the region which today's society considers impossible as far as water is concerned, ancient society tried to see what was possible through these different types of water harnessing structures to meet their water demand that to in a sustainable manner. The forms and names of these structures vary according to the different topographies of the earth. These structures could sustain people in very extreme climatic conditions including consecutive droughts and famines. The number of structures, their design, size and their management systems were well defined based on the water demand. Though these structures are many centuries old, they help meet the water demand of people in desert region. All these arrangements had been made by society on its own and their strength is such that even after so many years, they are still holding firm in one form or another, and upholding the strength of society. Except in some parts where state intervention, in terms of making alternative water supply systems, the traditional systems went out of use and partially destroyed for their neglect.[11] However, little rainfall would fall in the desert region, the catchment areas of these structures were capable enough to store every drop and fill up the structures and meet the drinking water needs of the human and livestock populations.

[11] For more details on the strength of these traditional structures and society, see Anupam Mishra (2001), "The Radiant Raindrops of Rajasthan", RFSTE, New Delhi.



Traditional community rainwater harvesting structure in the desert of North-eastern Rajasthan.

As regards total water availability and the management of that accumulated/stored water, these were marks, symbols etc. that can be understood by common people to know after the rainy season the total amount of water available for rest of the year. For example the Amarsagar lake in Jaisalmer, on a flat surface, a lion, an elephant and a horse have been made in stone at different heights to show the level of water in the lake. The whole town use to know what amount of water has been collected and how long it will last. Based on the availability of water the use pattern was self-regulated by the society.

The traditional structures were good enough to provide drinking water security to the animal and human population in the desert area. Unfortunately the modern state with its technology, manpower and wealth have failed to provide safe drinking water security to population in desert region of Rajasthan even after the 60 years of independence though large investment has been made to bring canals in the region. Even today there are many villages where people had cared to maintain their traditional water systems, there is no water scarcity. While in villages where people have neglected their traditional sources, drying up of the public source or breakdown in pipeline makes them more vulnerable than others who have maintained their traditional sources. In fact recurring droughts had forced the community to remember and maintain their traditional structures. There is something very attractive about modern technology, howsoever irrational, unsustainable, or ecologically destructive it may be on occasions.
Much conventional development has eroded the capacities of communities to self-organise, even to the extent of robbing them of self-respect. The outcome is resilience depletion. Resilient livelihoods are those that can first recover (self-



organise) after disruption and, following recovery, are capable of learning and adapting. They are strong enough to cope with surprises and change, as condition requires.

5.7.3 Food security

Besides drinking water security, food security use to be the second major issue for people living in the desert region. The average rainfall varying between 100 mm to 250-300 mm and except for a few rivers, like the Luni, there are no rivers which flow for twelve months there was great problem in producing sufficient food to sustain even the low density of human population. Whatever flows generated with this meager rain nalah flow and disappears in the sand dunes. Yet the society could find ways to produce enough food for their survival except in severe drought years or consecutive drought years. Multiple strategies were evolved to meet the food requirements by organizing efficient combinations of land-water-vegetation-livestock.

People have developed time tested mix-farming system to minimize climatic risks. They try to adopt a cropping system, which is combination of cereals, pulses, oilseeds, etc. along with number and type of livestock in a household. Mix farming involves the distribution of production risks between the two subsistence techniques of crop cultivation and animal husbandry. The crop combinations to be taken up in a year is based on the timing of occurrence of first rain, prediction about rainfall in a year based on traditional knowledge, and the composition of livestock. The main kharif crops are Bajra, Maize, Jowar, Green gram, kidney beans, Sesamum, groundnut, Guar, etc. If there is timely rain and rainfall forecast is normal, farmer will grow Bajra as sole crop in larger part of the holding and rest of the crops in smaller area. But if rain is delayed will cultivate pulses and guar, or mix crop of bajra, sesamum and beans, etc. The crop combination will depend on the expected rainfall and type of landholding. Livestock enterprise is less risky than the field crops. As livestock rearing creates demand for fodder, consequently it also influences the choice of crop to be cultivated, i.e., favoring crops, which can provide more fodder for animals.

The variety of measures through which the farmer's strategy is operationalised to form a traditional farming system, as termed by Jodha (2001), are (i) folk agronomy, to cover cropping and agronomic practices, (ii) ethno-engineering, to cover traditional mechanical measures, including those for moisture

conservation, (iii) indigenous agro-forestry, involving complementary uses of annuals and perennials, (iv) occupational diversity, including a range of activities and practices, often having non-overrate flows of output/income and input requirements, (v) self-provisioning systems, implying greater dependence on own inputs and outputs for production and consumption, and (vi) collective sustenance, covering traditional forms of mutual self-help, dependence on common property resources, etc.[12]. These are farmers' experiences accumulated over generations. While some of them are still effective, others are under strain because the circumstances in which they were developed have, of late, considerably changed.

Beside the development of excellent rain fed farming system the society was capable enough to identify structures to support dry land agriculture by storing water to grow crops in *rabi* season. One of these structures is known as *khadeen*. K*hadeen* is a sort of temporary lake. On two sides, a *pal* (*bund*) is raised and on the third side a strong stone sheet is fixed. The pal of a *khadeen* is called *dhora*. The length of the *dhora* is calculated according to the influx of water. Many *khadeen* are about 5 to 7 kilometers long. The small streams, which flow during the rainy season, are held in these *khadeens*. The water gets dried up by the beginning of Rabi season but lot of soil moisture is retained. Farmers utilise this soil moisture to grow wheat and other winter crops. Rabi crops in desert area are impossible without these structures. These structures are still very relevant and help people to cope with drought, as they provide food and fodder security.



Sorgham (Jwar) in Khadin at Baap



Khadin With Boath Side Wall Spillway

12 For more detailed discussion, see Jodha (2001) Chapter 2, pp.46-87).



5.7.4 Fodder supply

Animal husbandry is an important component of household livelihood strategy in the desert region. People keep animals based on availability of fodder, grazing lands and water. Animals are part of adaptations to mitigate or reduce the impact of climate variability, particularly disasters such as drought. They provide food, nutrition and income to household in all conditions. People in Rajasthan have developed special systems of rearing large and small ruminants. There are communities specializing in rearing of camels, sheep, goats, donkey, cattle etc. To protect these different types of animals they have come up with special breeds of these animals in different parts of desert and these breeds are also recognized by animal scientists. There are large number of descript breeds for each type of animals. Animals in desert regions are productive and more resistant to climate variability. Animals are good source of supplementary income, food and mobile asset.

The combination of large and small animals is to meet the short run cash requirement and also asset to establish household credibility in market and moneylender. Goats and sheep are also affected by drought, but little compared to large animals. They are mainly grazing animals and depend on common property resource i.e. grazing lands, wastelands, forests etc. Moving them to better-endowed areas saves them. Migration of small animals is traditional practice in Rajasthan. In case of wide spread drought they are taken out of State, and in worst situation sold for slaughter. There is ready market, round the year, available for these so they are the best defense to fight with drought. All caste, class and economic categories of household keep small animals for milk and ready cash. Goats are least affected by drought and can be raised at minimum or zero private cost, therefore, all income category households keep goats. It is for this reason that the number of small ruminants is increasing in Rajasthan much faster than large animals. One of the drought mitigation strategies of livestock raisers is that in adverse conditions migrate with their herds of animals (both seasonal migration and/or long term migration) within and outside the state depending upon the availability of fodder and cooperation of people on the routes of migration[13].

[13] For details see Purnendu Kavoori (1999), Pastoralism in Expansion: Transhuming herders of Western Rajasthan, Oxford, New Delhi.



Nadi in a village, human and livestock water source

5.7.5 Lessons from IK and modern tools for drought risk reduction

The study of the relationship between human beings and their environment has been a major focus of interest for social scientists. Droughts and famines are events where humans have devised strategies to deal with them. Notwithstanding the hardships posed by incidence of drought-proneness, large number of people continues to live in drought-prone areas. People in these regions have their own economy, and social organisation, which ensure their survival. Analysis of famine and drought generally tend to rely on macro-data, such as, food production, variation in rainfall, demographic and economic changes affecting large human and livestock populations spread over a vast region or regions. There is not much focus on the underlying reasons in understanding the adaptive mechanisms of drought at local level by different sections of society. As the policies for interventions are based on macro parameters large section of populations' problems is left unattended, particularly the most vulnerable section. Today, because of the development of road infrastructure, communication, health facilities, and access to basic amenities the state interventions are more market based or more of a nature where population with higher capacity gets benefited. The number of vulnerable population has increased as evident from number of human and animal migration and other indicators during drought years. It is mainly because the state has been less sensitive to the people's adaptive strategies or coping mechanisms, which vary across regions and socio-economic characteristics of the population.

By handling frequent droughts since Independence, particularly the two most severe droughts in 1987 and 2003 the state claim to have developed expertise in both efficient relief operations and planning short and long term mitigation



measures. The nation-wide launch of water shed development programme was the outcome of 1987 drought while NREGA of the 2003. However, the claims have not gone uncontested. In fact, in focusing on innovativeness, public policies have completely bypassed the important source of insights, i.e. the coping strategies of farmers, who themselves might be considered practical drought managers.

Dry-land farmers (including pastoralists) do not manage drought in isolation from the overall farming systems. They have developed their own coping strategy in keeping with the environmental and resource specificities, but the operational component of this coping strategy is under severe strain due to rapid demographic, technological and institutional changes. Drought and scarcity always loom large, minimizing the options for inter-year and intra-regional variability of production possibilities, and individual production and narrow specialization. Farmers, through different coping strategies, try to adapt both to good and bad rainfall situations whereas policy-makers and administrators often respond to only drought situation. Protection of drought-prone areas through periodic relief or through protective irrigation, etc. has been the focus of public intervention. Also the different components of drought management strategy as well as development strategy are less sensitive to the specificities of the resource base in these areas.

Through structural and operational features of their farming systems, drought prone area farmers are able to adapt and adjust to both long-term and short-term climatic behaviour (Jodha, 2001, p.48). Since grain production is uncertain, the traditional sustenance efforts are linked to overall biomass availability and stability and diversification through crop and livestock based farming mixed systems. Diversification through activities with non-covariant flows and flexibility of decisions and operations, being an age-old defense against risk and uncertainty, is practiced by dry-region farmers in the field of production, consumption and circulation (exchange) (Jodha, 2001). Since the spatial and temporal variability in rainfall and their consequences hit individual household more than the communities and since inter-household differences in endowments and capacities can act as shock absorbers at a group level, collective sustenance forms an important defense against weather induced uncertainties and scarcities. Their relative importance does vary according to climatic conditions. However, the economic and social conditions/environment is changing fast because of the national and global economic policies, along with the ever increasing demands of large urban and rural population. The traditional and indigenous knowledge and the evolved systems may loose their significance in this changed environment if



there are lack of efforts to improvise them and dovetail with the modern policies and techniques.

The major policy implications are: (i) the need to revitalise farmers' strategies, relevant today as much as in the past, through technological and other means; (ii) learning from farmers as drought managers, the need for public policies to integrate drought management with the overall development strategy for dry areas; and (iii) the possibility of achieving these two objectives of the rationales of farmers' strategy is made the explicit concern of integrated development and drought management interventions.

Since Independence, the drought-prone areas have to some extent benefited from development efforts and public support programmes. The state policies, to some extent, also reduced this vulnerability to severe scarcity, particularly famine, as was observed in 19th and 20th century. At the same time, most of the state initiatives leading to these gains have significantly affected the traditional adaptations/adjustment mechanisms making them unfeasible or ineffective. The public relief strategies to help the drought affected people were designed and pushed to such a level that they have more or less displaced the people's own adjustment mechanism and generated strong dependence on public relief/support.

Under the traditional strategies against weather-induced risk and drought, the measures designed for collective sustenance played an important role. As the collective initiative, developed as adaptation measures, were sustained by informal or formal understanding, and enforced through social and at times religious sanctions. However, in the changed demographic, socio-political and economic context, these social sanctions are no more effective. In consequence, all adaptation/adjustment mechanisms that derived their strength from social sanctions and the community's collective approach are less feasible.

The public policies and large number of rural development programmes pursued under different National Development Plans adversely affected the collective sustenance arrangements as most of them focused more on individuals rather than on groups of traditional types. The most important factor helped in collective sustenance and induced group participation in resource management were the village common property resources, unfortunately these have been privatised on a large scale, because of state failure to protect them.



Effective drought management cannot be meaningfully separated from agricultural development strategy for drought-prone areas. Just as the farmers' strategy attempts to integrate long-term adjustments to specific rainfall situations, public interventions should also approach drought and non-drought situations with an integrated strategy. The specificities of drought-prone areas, and their implications should also be explicitly recognised and integrated with development options to strengthen the farmers' strategy.

Drought and famine, recurrent phenomena in India have evoked considerable attention of researchers, because of changing state policies and programmes of interventions. The state has often been blamed for either not having done enough or for having overdone famine relief or the emerging corruption in interventions. The long and short term measures and approach to mitigate drought or provide relief are being questioned at different levels. The added dimension of political economy of drought has become an area of research and policy debate(for details see Appendix-I).

The state's perception of drought, measures to mitigate drought or to provide relief to the affected population is largely guided by phenomena like human and livestock migration, sell off of assets, demand for drinking water supply, food supply etc. by the drought hit population. Nowhere in the State Policy consideration for people's adjustment mechanism to recurrent droughts is being reflected. People and farmers especially in the drought-prone areas have adapted their economy/life style to the weather cycle in such a way that, on balance, the impact of adverse years is mitigated by the impact of good years. Seasonal migration, sale of assets (including livestock), borrowing from money lender friends, relatives, etc. during drought year is part of the adjustment mechanism evolved by people. Generally, state need not respond to signals indicating depletion of stock of assets or fall in incomes, instead food, fodder and water is provided as relief to affected population. State completely ignores the traditional community support systems, technologies to provide food, fodder and drinking water security and relief to migrating population. Population in drought-prone areas, including Rajasthan which experiences drought more frequently than any other meteorological division in India, have evolved systems to deal with food, fodder and water shortages without any outside support. The process of declaring drought/famine and taking relief measures in the past and even today is mainly guided by Famine Code prepared by British regime. There is a set procedure laid

out for each step and for measures of relief[14], these are now being revised at national and state level and suitable modifications are being made. In Rajasthan state new Famine Code is in operation. Despite all these changes the state always treats itself as donor/giver and affected population as receivers/takers, resulting in a dependency syndrome. The state initiatives have no respect to community initiatives or traditional practices to cope with drought. It has led to reflect and drifting away from community initiatives/measures/strengths to fight with adverse conditions and innovate/evolve community based systems for different kinds of natural disasters.

APPENDIX I



State Response to Drought

Since independence, large number of Rural Development Programmes, such as, infrastructure development (roads, communication, electrification), market network, new crop technology based on seed-fertilizer-irrigation inputs, and water-shed development, were initiated with different objectives of poverty reduction and

[14] For details see Jodha (2001, pp.20-22), Rathore (2003).



drought mitigation and relief. These have significantly helped the drought prone areas and population to reduce their vulnerability to severe scarcities caused by periodic droughts. However, most of the initiatives could not bring the desired results because they failed to recognize the high environmental diversity and resource specificities within the drought prone areas and relate them to the age long adaptations and coping strategies of the people. Similarly, generalized institutional programmes like land reforms, community development, projects, panchayat systems etc., were extended to these areas, without assessing their potential impacts on sub-marginal lands, common property resources, and climatic uncertainty. Public relief strategies to help the drought-affected people were designed and pushed to such a level that they have more or less displaced the people's own adjustment mechanism and generated strong dependence on public relief. Irrigation facilities were developed in a few pockets, but used on crops requiring high water, and in the areas well endowed with water. Dry crops in the process also suffered a backlash. Market integration took place, but it had serious adverse effects on strategic self-provisioning system and the fragile resource base. Even the special initiative like Drought Prone Area Programme supposed to initiate on basis of watershed and their specificities, in practice had not only discarded the concept, put followed the development process suitable for other better endowed areas. All this indicates the need for understanding and explicit consideration of specificities of drought-prone areas in both development strategies and drought management.

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CHAPTER 6

INDIGENOUS KNOWLEDGE IN ADAPTATION WITH FLOODS IN EASTERN UTTAR PRADESH, INDIA

6.1 An overview of cultural beliefs and practices regarding Flood in India

India and its subcontinent had been cradle for one of the oldest human civilization and it has a vast saga of history ranging from ancient to modern and medieval in between. Its long history has helped in developing its unique culture. Indian culture is characterized by multiple religious beliefs and practices, languages and traditions. This rich heritage of culture has been percolated down from the mythological time to the period of Vedas and the invasions by the Mughal Empire to the colonization by the British and these have greatly impacted on each and every community inhabiting in India and its sub continent. The geographical features further add on to this diversity. The different geographic zones are populated by numerous tribes and ethnic groups maintaining their distinctive cultural identity. And each community have developed a system of knowledge through which they try to find the meaning and answer to every unexplainable phenomenon like the beginning of the universe or the cosmology, origin of the human race and the natural hazards which could destroy the natural creations.

The States which lay in the Indo-Gangetic plains of India have been vulnerable to floods since time immemorial as the plain is formed by the three river systems- the Indus, the Ganga and the Brahmaputra. The state of Uttar Pradesh which is also a part of the indo gigantic plain has been considered as one of the oldest Cradle for Indian civilization as most of the ancient cities and towns sprang up near the river basin of Ganga and some of the Hindu mythological epic like the Mahabharata and Ramayana originated from the this place. One of the

Hindu myths also reveals how the flood or deluge is created to end over the cycle and rid the world of the evil age.

6.1.1 Beliefs and practices

According to Hindu mythology, floods are caused to end the evil age and start a new phase. There is a common myth regarding flood which goes as follows; *Manu, the first human, saved a small fish from the jaws of a larger fish. The small fish beg the manu to protect it. Manu kept the fish safe, transferring it to large container and as it grew it was transferred to larger container. When the fish grew large enough, it finally returned to ocean. Because of the kindness shown by the manu, the fish returned to warn Manu about an imminent flood in the coming days. The fish ask manu to build a boat and stock with seeds and samples of every species. When the flood waters rose, Manu tied a rope to the fish's horn and the fish led him to a mountain and told Manu to fasten the ship's rope to a tree so that it would not drift. He stayed on the mountain (known as Manu's Descent) while the flood swept away all living creatures. Manu alone survived.*[1]

Thus the belief about the cause of flood is deeply rooted in the Indian culture. Besides the flood there are also beliefs related with rivers, water bodies and water. The river Ganga which is holiest of all are belief to be heavenly and brought down to earth by the king Bhagirath, to wash away the sins of his forefather and many holy cities grew near the river. Many rituals and festival related with the river are celebrated. Of all these the most significant one is the Kumbha Mela, during which millions of worshippers take dip in the river to wash away from their sin. There are also other festival related with the river like the ‘Ganga Dhara’ and ‘Ganga Dashara’ in which the main theme is to thank God for giving food, water and shelter. Beside rivers water has got aesthetic properties and play an important role in myths and religious rituals. According to Hindu myth the lord Vishnu, the god of existence resides in the water. Life originated from water and develops into different species as explained in the ten incarnation of the lord Vishnu. Incarnations through ages start from the water as fish and continue as a tortoise, to boar and lion and to a perfect human being. In all religious rituals sprinkling water is an inevitable part in which the water is purified by ‘mantras’, inviting the presence of seven sacred rivers. Most of the Hindu festivals are also associated with fasting which local people follow readily. Fasting as religious practice also give people the endurance power to cope during the scarcity of food.

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[1] Deluge myth- Wikipedia



Above all these, religiosity and belief in disaster as creation of god give them mental strength to cope with vast devastation caused by the disasters. An anthropological study which was conducted during the late 1980s and early 1990 among the people who live on the banks and Island of Jamuna River reveals that when the researchers asked the people about their views on risks, a significant proportion explained them as the will of god, and saw prayers as the best response. The researchers concluded that the people were largely fatalistic and their strategies for managing risk were limited. Another Anthropologist on the mid river island obtained a similar response when a study was conducted by using a standard questionnaire few years later. However, indigenous knowledge is often not easily expressed in words, and the anthropologist observed something quite different when she lived on the island during the 1998 floods. Then, she observed that people were following a variety of strategies that had been used on the island for the generations. They built platforms out of reeds and banana stalks for their animals, fixed beds below the roof, cooked on portable ovens, lived off stocks for food saved from the winter harvest, switched temporary to other source of income and referred to wide network of relatives. At the same time, people expressed their faith for God interpreting the high floods as his way of showing his power and testing their beliefs. God was thought to have sent the floods, but he also gave the strength to survive them.[2]

6.1.2 Predicting weather and rain

The beginnings of studies on weather and water India can be traced back some thousands of years. Early philosophical writings contain descriptions of earth's revolution around the sun, the seasons, and the processes of cloud formation and rain. Though 'Indra' was worshipped as the god of rain, the ancient scholars knew that basically the energy of the sun cuses rainfall. Rig veda says that the sun is the cause of rainfall and water (Adityat Jayate Vrishti or the sun gives rainfall) that evaporates by the sun's ray moves up into the sky for conversion to clouds and rainfall and then is finally stored in the rivers and ocean. 'Arthashastra' contains of records of scientific measures of rainfall in various part of India and its application to the

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[2] Source of the study: H. Schmuck, '"An act of Allah". Religious Explanations for the Floods in Bangladesh as survival strategy'. International journal of mass Emergenceis and disaster, vol.18, no. 1,2000, pp.85-95 in Twigg, John. 2004. Risk Reduction: Preparedness in the development and emergency programming. Good practices review.no.9, March 2004, pp. 136. Humanitarian Practices Network: London



countries revenue and relief work.[3] However the local people have their own ways of predicting weather and rainfall by observing the physical environment. The old farmers could even predict drought and flood by the observation of the pre- monsoon weather. To them the position of the celestial bodies, clouds, wind and the behavior of birds and animals were indicators of the nature of forthcoming rainfall and the availability of the resource. Often, the people anticipate flood by observing and interpreting local, environmental signals- listening to the sound of the river, seeing the wood and dead bodies of animals and snake floating in the water, smelling the foul smell of the river and the muddy taste of water. Thus a close observation on the surrounding environmental condition, people are able to anticipate the impending flood.

6.1.3 Behavioral change as coping and adaptation strategies

It has been widely reported that when flood hits the place, livelihood of the people was enormously affected; people have to face many problems in adjusting with the disrupted environmental condition. And people find different strategies to adapt to the flood situation. The strategies may be in the form of behavioral change in terms of food habits and sanitation habits. A study undertaken by the BARC (1999) in the flood affected areas in Bangladesh found out that when flood hit, the food habit of the people changed during flood both in quality and quantity. Instead of three meals a day, at best they could manage two meals – that was true for those households who could manage an alternative source of income and took meals for the day. Those who could find a dry place and fuel, used to cook once a day and prepared meals for the day. Sometimes, they cooked for one day and took meals for two to three days……others tried to survive on dry food like muri, chira etc with or had rice with only green chilly. They didn't prefer 'ruti' because it needed much fuel to prepare[4]. Some of them also starve in spite of having food due to lack of fuel. Besides the food habits, people had to change their sanitation habits. Sanitation posed serious problem, especially for the women. The practice of seasonal or permanent migration also helps people to cope with the different type of stress caused by the flood.

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[3] K. Shadananan Nair, 2004: Role of water in the development of civilization in India- a review of ancient literature, traditional practices and beliefs in the basis of civilization – water science?. Edited by J.C. Rodda and Lucio Ubertini

[4] Ahmed et al, 1999. ***Experience of the Deluge: Flood 1998.*** Research monograph Series no.15. BARC: Bangladesh



6.1.4 Indigenous technology

The flood affected people in both rural and urban areas cling to their own homestead as long as possible. When the water start pouring, they make platform out of bamboo and shift their belonging to the raised platform. As the water level rises they increase the level of the platform and if not possible they move to the roof of the house. But when everything is inundated, people take shelter in the nearby school or the roadside make shift shelter. For transportation, people use boat for going far off places but for moving within the village they use raft made of banana tree, sometimes they had to buy the tree from their neighbour. Most of the time, they swam or used large cooking pots or pitcher to go to neighbouring places. People not only use local knowledge for saving themselves but they also use method to save their poultry and livestock as they are valuable assets . They build makeshift shelter in the high and dry places and try to feed them as best as they could manage. Sometimes they even share their food like ruti. When fodders are not available, water hyacinth are feed which may sometimes cause diarrhoea among the livestock and may be the major cause of mortality in the post disaster period[5].

Communities in the Tarai region (Indo-Nepal boarder) use many strategies to cope or adapt to the flood situation which include both short-term and long-term strategies in term of construction of houses, elevated stores, protection of the wall, drinking water and transportation and other measure like diverting the streams to reduce the impact of flood. Dekens (2007) reported on how the people living in the flood prone areas use elevated structure to keep important and valuable materials like food grains, gold, documents, and clothes. Elevated structure called 'kothali' or 'berhi' in Maithali or 'bhakari' in Nepali are built for storing grains. Other elevated structure includes multipurpose platforms, locally called 'machan' and circular mud-made repositories, locally called 'chakka' are built to keep the valuable items.[6]

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[5] Ahmed et al, 1999. *Experience of the Deluge: Flood **1998.*** Research monograph Series no.15. BARC: Bangladesh

[6] Dekens, J. (2007). *Herders of Chitral: the Lost Messengers? Local Knowledge on Disaster Preparedness in Chitral District, Pakistan***.** Publ. International Centre for Mountain Development: Kathmandu, Nepal



6.1.5 Economic practices

The coping strategy also includes generating alternative source of income which majority of them could not do. Some of them who could manage to get loans from the money lenders or other sources tried to earn money with other occupation like ferrying people on the boat, catching fishes where ever possible, ferrying people in the inundated roads in the small boats or the rickshaws in the urban areas etc. However majority could not manage any alternative source of income so they have to borrow from their relatives or the moneylenders. They also burrow daily necessities from the local grocery shops or the well off neighbours or advance sells of labour or crops. Selling of their valuable assets of the family, ornaments, poultry and livestock are also common.

In terms of agriculture, people living in areas where flooding is an annual event do not plant *Aus* but cultivate deep water variety of *Aman*. Flood imposes certain health challenges among the people. During the flood, they have little opportunity to seek treatment for the illness. Either they do not have money or there is no health care provider. In such condition people rely on the traditional health care practitioner like ‘Huzur’ (religious healing), ‘Fakirani’ (female faith healer) or the ‘Phook Phak’ (faith healing). People do not pay much to such folk healer[7].

The most common practice is of male member of the family seeking job outside the village to earn money which could compensate the loss of income and properties during the flood. The recovery may in the form of constructional change in their houses and increase in their existing insurance policies and micro finance.[8]

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[7] Ahmed et al, 1999. *Experience of the Deluge: Flood **1998.*** Research monograph Series no.15. BARC: Bangladesh

[8] Dekens, J. (2007). *Herders of Chitral: the Lost Messengers? Local Knowledge on Disaster Preparedness in Chitral District, Pakistan***.** Publ. International Centre for Mountain Development: Kathmandu, Nepal

Strength and weakness of the Indigenous Knowledge and practices

IK	The indicators/practices	Remarks
Early warning /anticipation	• Behavior of animals, bird, reptiles, amphibians, insects, vegetations and tress • Direction of wind, temperature and celestial bodies • Color of cloud, location, unusual sounds, changes in water flow, color of water, smell of water and taste of water	Such type of knowledge might be confined to only few special persons. Dissemination to the general mass is a must. But the validity and reliability of the knowledge is questionable. * In any case, such knowledge always enhance the preparedness of the community to face the disaster
Preparedness and Coping	• Stocking and preserving food • Plantation of early maturing and flood resistant plant species • Keeping seeds in high and safe places • Storing fodder at higher elevation • Constructing raised platform with bamboo and wood • Making boats and rafts with bamboo and banana stem • Constructing houses on the slits • Change in food habits • Change in sanitation habit	Stocking and preserving food entirely depends on the availability of the food to stock and amount might not be enough. It is also a time consuming process. At the time of the crises enough amounts of seed for planting or fodder might get depleted during the prolong flood. Constructing raised platform might not be able to resist physical impact of the flood. Skill for making boat or raft or houses are specialised among few people only. All might not afford it. Changing food habit and sanitation might impose a great challenge on the health of the people. Majority of the people cannot generate alternative source of income. *In spite of all the

	• Generating alternative source of income • Depending on network of relatives and friends	limitations, indigenous coping strategies mitigate the impact of flood
Relief and Recovery	• Depending on networks of relatives and friends • Using locally available expertise and locally available materials in building temporary shelter and cattle sheds • Post flood repairs and maintenance of village road, bridges and shelter • Using knowledge about healthcare and home remedies for different health challenges • Rescue of livestock and vet nary care • Religious ceremonies and performance of rituals	Increasing uncertainty, burden of poverty and frequent dependence, may break down their social bond leading to people becoming more self absorbed in their own family's survival. Local expertise and material may not be available to all and wholly depends on the affordability or the economic condition. Indigenous health care practices may not able to give effective solution to the certain diseases. Religious ceremony and rituals may often mislead about the perception of the disaster and the risk. However it also provides psychological and emotional support to the trauma caused by the disaster. *Local method provides the immediate relief and recovery at a very low cost before any intervention from the external agencies.

It has also been found out that coping strategies of the people are very diverse and rely on different factors like culture, social organisation, technology and economy. On the other hand a change in the economy and the social structure affects the indigenous knowledge and often undermines the knowledge system.



However, indigenous knowledge can be incorporated in developing a people friendly plan and policies weather it in flood management or other developmental programme. Incorporation of indigenous knowledge will help in the empowerment of the local people and their development thereby increasing their self sufficiency and strengthening their capacity and self determination. Using the indigenous knowledge and resources in designing developmental plans will enhance the credibility of the plan among the local people and might be able to generate a sense of responsibility thereby increasing their participation in disaster mitigation and recovery. Thus, a strong system of Community Based Disaster Risk Management (CBDRM) can be developed.

6.2 A Field Study and Analysis of Indigenous Knowledge Practices

In the present study, the focus was placed on studying the indigenous knowledge of a community living in a flood prone area and understanding the way members of the community are adapting to floods using their indigenous knowledge system. A fieldwork was conducted among the people of Golaganj village in Bahraich district of Uttar Pradesh. There are various factors for choosing this village as the area of study. One of the main criteria is that the village is a perennially flooded area and it is relatively isolated. Other factors or the criteria for the selection of the particular village are (i) the village is isolated in the sense that there is no private or public transport system and the villagers had to walk for about 4 kms for the nearest bus stand, (ii) the educational level of the villagers is not that high, (iii) there is no post office, police station or a proper temple in the village, (iv) there is no proper crematorium or a community hall in the village, (v) many of the household have been displaced due to flood and many are still in their original place, (vi) there is no basic amenities like proper drinking water, sanitation, health services and electricity in the village, (vii) there is no enough intervention from the NGOs, except for the one which has stopped its work in the village and intervention from the governmental organization is very poor. For the present study only three wards namely; Kothar, Kaharanpurkha and Pradhanpurkha were selected. The study also includes the displaced households who are taking shelter at the bank of the dam. During the study an attempt has been made to understand total social order of the village with especial reference being given to the cultural, religious beliefs and practices and their basic institutions like family, kinship, marriage, economy and political organization etc.

6.2.1 Methodology

Here the data used are mainly primary data collected from the field area. However some secondary data related with district and state are also used.

The primary data were collected by using certain methods which includes-

Social mapping: It was done in participation with the villagers. It revealed certain information like the settlement pattern, types of the houses, total no of household, the ethnic composition and demographic profile, source of income of the households, areas of important places like schools and temples, the village path, cultivated areas, safe areas to evacuate during the flood etc.

Observation: The trend of observation used in the present study was quasi-participation observation which is mid-way between participant and non-participant observation. The activities and interaction between the villagers were observed from a distance since accepting an outsider as a part of them was difficult. Hence maintaining the position of a researcher, observations were done by remaining at the periphery. However, their activities, interaction between people, behaviour of neighbours towards each other, behaviour of family member and behaviour of the people at various places. All these observations helped in bringing out a vivid picture of the kind of life they live in the present time.

Group discussions and interviews: For this purpose an interview guide was used where a list of questions were structured beforehand and attempt were made to capture history of the community, condition of the environment in the past and present, changes in the population, changes in the economic practices, the present political scenario, social stratification of the community, number of family in each category, profile of natural hazards and disasters that have affected the community, the most destructive disaster according to the memory of the people, types of disasters that have occurred, periods of occurrence of disasters, numbers of families affected, type of the assistance they got from external agencies, traditional/indigenous Knowledge on economic practices, social institutions and social practices, religious activities and festivals, division of labor between the family member, traditional knowledge about the prediction of weather, rain and flood and traditional knowledge on the other technologies which could mitigate and hence enhance the resilience of the community to hazards.



6.2.2 The site of the study

The village is situated at the bank of Ghaghra River. The village is situated about 30 kms in the southern part of the Bahraich town. Even though the village is not far from the town in terms of the distance, the connectivity to the village form the town is very poor. There is no private or public transport system to reach the village. The villagers have to walk a distance of about 3 kms for the nearest bus stand which is located in Boundi. Till now there is no proper metallic road to connect to the village. An elevated mud dam has been serving as the road since 1956. But before that there was no proper road. The villagers had to pass through the agricultural field. The village is divided into different ward or locality. They are: Kothar, Tigra, Teigahanpurkha, Pandhaypurkha, Chamaranpurkha, Bachupurkha, Pradhanpurkha, Kaharanpurkha, Tribedinpurkha, Dhobinpurkha, Nayapurkha and Tapri.



Many of the houses were dislocated many times due to cutting of land by the changing river course. There is no proper foot ways to pass through the houses. There is only one muddy foot path which interconnects the localities of the village. For going to some localities the villagers have to pass through the agricultural field.

6.2.3 Infrastructure and basic amenities of the village

The village is not electrified however the erection of electric post and wiring was started last year. So, the households in the village rarely own electronic gadgets. But few household owns radio.The police station is situated about 4 kms away from the village which is in Rajabaundi. And there is no post office in the village. According to the villager neither any postman nor letter comes to the village. The nearest post office is in Shankarpur which is about 4 Kms away from the village.The households do not have sanitary latrines and the villagers go to open fields for sanitation.There is no primary health centre in the village and the villagers had to go to the neighbouring town Baundi for the treatment.

6.2.4 Socio demographic status

The population consists of Thakurs, Brahmins, Kahar (kayasth), Yadav (ahir), Lodh (Rajputh), Gupta (bhujwa), Chamars (Harijan), dhobi, Pasi and pal. Only 152 household inhabiting in the three wards were selected for the study. The data reveals that of these households-49 are Kashyaps, 32 are Yadev, 30 are Chamars, 19 are Lodh, 10 are Pals, 5 are Guriya, 4 are Kahar, 2 are Thakur, 1 is Burma.

6.2.5 Key findings

The most convenient way to understand and envisage the total social order of the society is to look into and study the major institutions and the relation between the institutions. Thus to understand the social order of the village Golaganj, an attempt was made to grasp the basic social institution like family, kinship, marriage, religious beliefs and practices, economy, political organization and festival which also provide the complexes of recreation. All these reflect the condition of people or the society. Looking at these conditions on the other hand provided an insight on assessing the risk and vulnerability of the people concern.



I. *Cultural and social factors*

A) Family

Among the 152 households, 76.31% are nuclear family, 9.81% are incomplete family, 8.56% are joint family and 5.26% are extended family. The family has been classified in terms of the members sharing same kitchen with common pool of income. Nuclear family consists of a single married couple with their unmarried children. Incomplete families are those families which do not consist of any married couple. Joint families are those families of two or more married couple with their children and extended family consists of a single married couple with their unmarried children and another relative.

Nuclear family as an adaptive strategy: Family is the basic unit of every society and Golaganj is not an exception. According to the villagers, family members are extended part of oneself, whom you share your burden at the time of difficulties. The villagers also feel that having a large family is helpful at the time of flood. Large family means division of labour and sharing the burdens. It also means more number of earning members. In other words, having a large family is like having more social capital. According the people, having a joint family is good when they have a permanent source of income like agriculture where the members of family work together and income earned is shared. But at a condition where people are leaving on hand to mouth, without any permanent income, it is difficult to decide who earn and who consume. Pooling the income from different persons is also difficult. So it is better to separate after the sons get married and they become responsible for establishing their own family. It on the other hand, prevent from creating indifferences between the family members. As for the aged parents, they can always bank on their married sons for their livelihood. The siblings, even though they have different families support each other at the time of need. Thus, having nuclear family can be considered as an adaptive strategy which the people have adopted to adjust themselves with the deteriorating economic condition. Otherwise, having a large joint family is a common characteristic of villages in India.

Role of family members during flood: As flood is an annual phenomena in the village, every member in the family are well aware of their role in coping with the flood. People are also well coordinated in their role in the preparation to flood.



Generally women take care for storing and preserving food while men make sure to earn enough and save so that it can be used at the time of the flood.

"*When the rainy season starts, I start looking for the trees which could be used for making Machan. When the level of water increases and starts entering the homestead area, I immediately cut down the tree and make Machan, and my wife start packing the valuable in a bundle and assemble the children at a place. Usually the Machan are made beforehand, it can last for a long time if it is made up of good wood but most of the people cannot afford to buy wood. Those Machan which are made up local trees do not last long. Then all the clothes, food grains and other household thing are kept on the machan. After that the khathiya (charpai) is tied with rope at the wooden or bamboo bar which supports the roof of the house. The rope is bought beforehand but most of the family makes it with the stem of a special type of shrubs which is locally available. When everything is lifted up, I take care of the cows and other livestock; they are shifted to other higher and safer places. My wife arrange all the necessary items for cooking, she made a portable chulla (hearth) and pihan (platform) beforehand. All these items are lifted on the khathiya for cooking and take care of the children. As for the food, my wife has already stored enough dal (pulses), vegetables, flour and maize which could last for ten to fifteen days. When things are kept in the right places, there is nothing much one can do, the only thing is to sit on the khathiya and pray to the all mighty to save us and not to make the water level to rise. When the water recedes from the houses, we try to bring back ourselves to the normal life. I go out to earn money and my wife looks after the household works and the children*". (Kesavram Yadav, 45)

B) Kinship as a social capital

Kinship plays a very important role in the social organization of Golaganj. Kinship acts a guide in establishing many social relationships in which a person is likely to be involved in the course of his/her life. The villagers of Golaganj explicitly use the categories of Kinship to define social relationship. Two terms are generally used for the social introduction that is the lineage and the caste. Both classificatory and descriptive terms are used for addressing one another. Associated with the kinship, certain types of behaviour pattern are found in Golaganj. A woman avoids her husband's elder brother. On other hand a woman shares a friendly relationship with her husband's younger brother. There is also avoidance between father- in-law and daughter-in-law.



"Before my house was near the river, I have seen many floods in my lifetime. My house was shifted two times before. This is the third time and my family has been living here since 2004. All the neighbouring houses have been displaced several times. I didn't have land to build house. The place where I am building my house was given by one of my relative. I didn't have money to pay them for the land so I had to pay in installments. But for some family, they do not have anything to pay so they have stayed without paying anything". (Ramkilal Yadev, 73)

"Flood has been a yearly phenomenon in the village. But before, it was not that destructive, cutting of land started only few years back. But at times there was heavy flood before also. So, it is not safe for the women and children who do not know how to swim. So, I send my daughter- in- laws to their maternal homes along with their children during the time of flood." (Prem Kashyap, 76)

Thus, relatives and kinsmen are a source of financial and moral support for this flood affected people Golaganj. And they also heavily relay on the support given by the kin members and the relatives. Having relatives at places which are not affected by the flood is an asset to the families of the village.

C) Marriage

Golaganj is a Patrilineal society and caste endogamy is strictly followed. Marrying a woman from lower caste is considered to be demeaning. A women change her surname after marriage to that of her husband. The system of dowry was highly prevalent at one time. Marriage by engagement is the commonly practiced. Usually the family of the girl initiates the talk about the marriage proposal. The parents of the girl have certain set criteria which they look for in their prospective son in law. When the suitable boy is found, the parents of the girl initiate the talk, and then negotiation about the marriage begins and the tilak (vermillion) is put on the forehead of the boy when the alliance is finalised. If one or the other side regards the union as unsuitable, negotiation stops immediately. If the match is found favourable, then the contract is finalized. Then, a date is fixed for deciding the day of ceremonial marriage and other preliminary functions. Usually marriage rituals are held for five days. The *bharat* (the marriage parade) starts from the groom's side and heads towards the bride's place for the ceremony. The expenses for the wedding are generally sponsored by the family of the bride and also serve the entire guest for the ceremony with food and drinks.

However in the present time, there is drastic change in the marriage rituals and practices. The caste difference is slowly breaking down and there are few cases of higher caste marrying women of lower caste. And the rituals are shorten with the bharat leaving on the same day of the wedding On the other hand, villagers are more concerned about the fact that it has become very hard to find a suitable spouse for the village youth as nobody wants their daughters to live in flood affected areas. As the economic condition of the villagers is poor, giving dowry is no more a trend.

6.2.6 Economic factors

The economic practices: Few years back agriculture was the main occupation of the villagers but due to the cutting of the land by the changing river course, not much land are left for agriculture. At the present time, the villagers heavily relay on wage labour. Male migration to other states like Punjab and state capital Lucknow for earning has become a phenomenon among the villagers. The table below shows the mode of income among the 152 household.

Numbers of household with different source of income

S.No	Source of income	Number of household	Percentage
1.	Government job/pension	5	**3.3**
2.	Agriculture	25	**16.4**
3.	Wage labour	122	**80.3**
	Total	152	

Since time immemorial, agriculture has been the main source of income among the villagers of Golaganj. As the history also reveals that, the village was once known as Golaganj Seher that is the city, for its rich agricultural and dairy products. But from the time, the river started changing its course and coming nearer to the village, the scenario in the economic practice has totally changed. As time moves on the river also came nearer and cutting of agricultural land and houses started. Another factor which adds on the impact was opening of barrage in Nepal. The cutting of land by the river has left many of the household landless. In such condition, villagers started looking for an alternative source of income. Some started migrating from the village in search of job and some found out an alternative way of farming. Women who generally look after the household chores start taking part in income earning works. Thus the source of income becomes diversified.



Crop destroyed by floods

"Now I am old, I cannot do any physical work, in younger days I used to do agriculture. We used to live in a locality called 'Daryapur'. About 3rd to 4th generations of our family lineage have lived there in Daryapur. Now, Daryapur is no more, it has been totally washed away by the river. So, nothing is left with me neither the physical strength nor the land to cultivate. Flood has taken away one of my son too, he died when he was a child. One son left for Jhaladhar in Punjab to earn money. There he used to do wage labour and pull rickshaw. He used to send money for us, we were totally dependent on him but unfortunately, he was injured and he died in Jhalandhar. Now two sons are left, one looks after the animals and work as a wage labour and other one is boatman and he looks after and sails the boat of the village Pradhan."(Gurbachand Yadev, 78)

"I have four sons. All of them go to work at other places like Jhalander and Lucknow. There they pull rickshaw, work as wage labour in construction site or take part in carpentry work. They stay there for two three month and come back again after earning some money. They stay at home for some time and go back again as there are no proper work in the village and the neighbouring areas. I am dependent on them for my livelihood."(Jwala Prashad, 65)

Male migration as a means of alternative income



As stated in the above mentioned case studies, people have started to move to other places like Punjab or the state capital Lucknow to earn money. In fact, in the present time, the villagers are heavily relaying on the income generated from the wage labour and money remitted by the family members who has gone out of the village to other towns. However, in many households, where the number of the family member is less, male migration is difficult. The male members are reluctant to leave behind their wives and children with no one to look after them.

Mewalal Chamar, 34 said, "*I have five sons and one daughter. They are all child and none of them are mature enough to earn. They are all dependent on me. We don't even have our own land to build house. Now we are living in a hut built on the roadside of the dam. We shifted here about 8 years back. Our house was cut down by the river in the 2000. Since then I have been earning my livelihood by doing wage labour in the village and the neighbouring village. Sometimes, I work for wage in the agricultural field of other people or other labour work like carrying mud or stone. There is not enough work here in the nearby area so, it is better to go out and work but I cannot move out because it is not safe to leave my wife alone with the children. I don't even have a secure house, if I had had a proper house with secure walls and door, I could have gone to other places for earning money. Now at the present time, the incidents of stealing and thief have increase as people have no source of income. The other day, my wife left her silver anklet just near the door of the hut, it was a matter of few minutes and somebody has stolen that. In such situation I don't have the courage to leave them alone."* Thus most of the villagers are looking for opportunity to go out of the village to earn money and diversify their income and enhance their livelihood and recover from the loss of property and valuables caused by the flood.

Indigenous adaptive agricultural practices among the landless farmers*:*

Agriculture is considered very important among the villagers not only for the profit and giving a livelihood but also it give them food grains which could be stored for a long time and which is also the most important item for their survival. The villagers are born agriculturalist, so they take agriculture close to their heart. But, the natural forces have taken away most of their land, which are very dear to them. In such a situation, it is a real dilemma among the farmers. Nonetheless, the villagers found out a solution to their problem by introducing an agriculture practices known as "Attai-bhattai" in the local term. Attai-battai literally means

sharing into half. As the meaning indicates, in this type of agricultural practice, the landless farmers use the land of another person who has land. The farmer cultivates rice or wheat in those borrowed land investing their knowledge, money, skill and labour without any interference from the landowner. When the crop is harvested the total amount of the yield is shared by the farmer and the land owner on the basis of 50- 50. This practice has given a solution to the landless farmer who wants to grow crops for their consumption. But this on other hand creates conflict between the farmer and the landowner. The conflict arises mainly at the time of the sharing the yield.

Indigenous knowledge about the crops*:*

The villagers of Golaganj have a rich knowledge about the crops that suits the most in the present condition of the soil and the weather. People here cultivate different variety of crops at the different time and season of the year. Some of the most popular crops and pulses that are cultivated in the surrounding agricultural field are peppermint, sugarcane, rice, maize, masoor dal, mustard, wheat and other variety of vegetables. Intercropping is the most common type of agricultural practice in vogue. The villagers heavily relay on the variety of crops which can be grown together. Besides this, they also relay on variety of crops which give them food security and also which can resist flooding. Another criterion of the crop grown in the village is those which can be grown at the dry season that is at winters. Even though the people of Golaganj have a rich knowledge about the different type of crops and other vegetables, they do not plant all these crops and vegetables looking at the weather and flood situation.



Intercropping of crops as seen in the field

Fishing as an addition to food resource: The type of fishing commonly practiced by the people is mainly for consumption. Fishing by net is commonly practiced. Fishing is generally done by the male members and generally done in the river, large pits and ponds. It is also observed that even the small children catch small fishes form the roadside drains and gutters (where the water is shallow) without using any fishing implements.



A villager knitting fishing net

The people have adequate knowledge about knitting net.

6.2.7 Religious beliefs and festival

All the household in the village are Hindu. The cosmology of the villagers relate with that of the Hinduism. The villagers worship all the Hindu God and goddesses. According to the villagers the earth is created by Lord Brahma, destroyed by the Lord Shiva and the preserver is the lord Vishnu. The Indra Devta is the one who create the rain and rainfall. The Ganga Mata, the goddess of river Ganga is of immense importance to the people of the Golaganj village. Every time villager move out to the river, the pray to the goddess for their safety and well being.

There is common belief among the villagers that the King Mann Datta was a good ruler and he had a divine power. After the demise of the king people used to worship the shrine of the king. It is believed that when one offers water or flowers at the shrine it cures fever and other minor illnesses.

All the belief and practices are reflected in the festival celebrated by the villagers and they celebrate almost all the Hindu festivals. All the festivals are celebrated at certain time and season and villagers perform certain rituals related with the festivals which in one way provide them a kind of endurance power in coping with flood situation. Most of the festivals are associated with fasting especially during the Navratri which is celebrated twice a year, people even the young boys and girls keep fast for nine days, besides most of the women in the village keep fast on Sundays.

6.2.8 Housing technologies

Majority of the houses are built with thatch roof and thatched wall. The roof is made of long grass called *Phuj* (*imperata cylindrica linn*). This grass is generally grown at the river bank. Only few houses in the village are made up brick. There are also some houses which are made up of mud wall with thatched roof.

Indigenous adaptive housing technology: Since the village experience flood every year and the amount of rain during the rainy season is quite heavy, living in a mud house is not considered safe among the villagers. According to the villagers, the best type of house to protect them from the flood water is houses made up of brick and cement. But, at this time, when people could hardly afford a two time meal, building a brick house is beyond their imagination. But there are only few brick houses in the village where their near and dear ones take shelter during the flooding.



The most common type of house

For those who do not have a place to refuge, they had to stay in their house or rather the hut. At such a time living in a mud house is very dangerous because mud can melt down easily when exposed to water for few days. On the other hand, one needs to repair it after the flood. Considering such facts and economic condition people now prefer to stay in houses made up thatched wall. Such type of house are safer and do not crumble down easily. The walls are not easily destroyed even if exposed to water. And on top of that the walls and roof are portable and can be reused if one wants to shift to other places.



House being built on elevated plinth and cemented boundary

Not only in changing the housing technology, people are also trying to elevate their house as high as possible. And if they can afford, they try to make an embankment of the foundation of the house with cement and brick in order to prevent erosion during the flood**.**

6.2.9 Other adaptive technologies

As mentioned earlier, beside the change in the housing technology, there are certain indigenously developed technologies which have helped the villagers to adapt to the flood. The most important one is the making of machan or the elevated platform for keeping cloths, utensils, food items, valuable items, fodder for the live stocks, firewood, cow dung cakes etc.


Machan for storing valuable items during flood

Drinking water is one of the main problems when the flood water inundates all the low lying tube well. So, the best possible way to combat the problem is uplift the tube well at the higher place. People also try to build a mound with mud so that animals could be kept there when the level of flood water rises.



An elevated tube well and a safe place for the live stocks

The most important one which fulfils the need of everyone is the portable 'chulla' (hearth) and the 'pihan' (platform made up of mud). These chulla and the pihan are easily portable and can be carried anywhere when they take refuge during the flood. These can be easily lifted on a Takkat (a wooden platform) or a charpai (a bed made with wooden frames and rope). The women folk of the village are expert in making the chulla and the pihan. These are made of mud so it does not require

any expensive raw material. But it can be made with an expert hand because it may break if it not made in the proper way. Besides the chulla and the pihan, women are also expert in making Daheri (a mud depository for keeping food grains). The daheri are kept above a pihan, the mud platform. This help in keeping the food grains dry and hence help in preservation of food grains.



Daheri-mud container for food grains

The Daheri has an opening or a hole known as Aan, which is covered with a mud plate. This mud plate can be easily broken down. So, when they anticipate that the water level is going to rise, the covering of the aan is broken and the food grains are transferred to the sacks. Those sacks are then again kept on the Machan.
The man folk on the other hand have their expertise in making house and Machan. According to the villagers almost every adult man in the village has knowledge about making a house and machan. They also make baskets for everyday use with the stem of locally available shrub known as jhao. An open mouth containers for giving fodder to the cows which allow efficient use of the fodder are also made by the male member of the family.

6.2.10 Folk tales

The most common folktale among the villagers is that the king Manndatta, who used to rule the village and the neighbouring villages. In fact this tale is a part of the history of the village. The elder generations narrate the young ones about how the village was once known for its prosperity and how many communities who settled there for the business purpose left the village. The villagers also narrate stories about the Ramayana and the Mahabharata. The tales are about how



Lord Ram was sent to exile and other related stories. As in Mahabharata, the stories of Pandavs are also a part of folk stories of the village. Thus the villagers are more inclined to the myth related to Ramayana and Mahabharata. The story of Birbal and Akbar is also a favourite among the villagers. According to the villagers, there is no folk tale related to the flood or the village and nobody ever thought of writing a story or a song because the villagers are almost illiterate and only few from the younger generation are literate, who are busy in earning their livelihood.

Quotations from the flood narratives

*"I have born in the flood, grown with the flood, eat with flood and still living with the flood."(*Surjalal Yadav, 85)
*"Flood is our enemy. Flood has taken everything, my land, my house and all my belongin*g." (Mewalal chamar, 34)
"*There used to be big trees near the river banks but when the flood come even those big trees are washes away, how the crops can resist*." (Gurbachand Yadav, 73)
"No matter how much Puja I do, how much fast I keep, flood never stop to come every year." (Kamala, 50)
"*What I can do now is to take my children to the river and say, 'son, learn to swim' and then ask them to learn to do labour work*."(Baghabati kashyap, 40)
*"When the water has surrounded from the every possible side and it was raining from the sky, I and my family were hanging loosely on the khatiya. Then I prayed to god, 'God you left have us nowhere to go, so, give us enough strength and power to hang on'." (*Shrikishan Rajput, 55)

***Trends of flood experienced in the past**:*

Flood has become a part of life of the people of Golaganj. Normal floods are expected every year during the month of July to October. However people have experienced floods of unexpected scale which are damaging. Before the problem was of inundation and the days of inundation with water also varies, sometimes it was of four to five days and the other times it may be more than a month. But the changing of river courses with the cutting of houses and agricultural land started since 2004. Since then the people are suffering from the landlessness and lack of economic resources which have greatly affected their livelihood.

According to the memory of the people, the pattern of flood has been changing over the past five years. It has become more frequent and unpredictable. Sometimes, the level of water rises inundating the houses more than one time in a year. So far the present generation has observed some devastating floods; one of the most miserable was in the year 1955 and one was in the year 1983. During the 1955 flood, the level of water was so high that impact spread to a vast areas and it reaches to villages which lay far off from the river. At that time people faced a lot of difficulties as there was not a higher place to stay during the flood. So, the people persuaded government to build an elevated dam so that flood water do not reach villages which are far off from the river and also to provide an elevated place where people stay during flood. Since then, this dam has acted as a safe place to take shelter during flooding.

6.2.11 Indigenous knowledge about anticipating rain & floods

As flood is an annual phenomenon among the villager, they have rich amount of knowledge regarding prediction of rain and flood. Some of the indicators are the behaviour of the animals and change in the environmental condition. Thus by observing and interpreting environmental warning signals, they manage to prepare themselves for the impending flood. People already find a safe place for themselves and the cattle and also preserving foods and firewood. With this skill of identifying the signs, people have been coping with flood.

Environmental signals

a. When there is heavy rain for ten to fifteen days continuously, flood is expected. Many a times the water level of the river rises even when there is no rain in the village and the nearby areas but when it rain in the higher mountainous region. So, when we see black cloud and its roaring sounds of clouds, flood is expected.

b. When the soil become very moist and wet, it is expected that flood will be coming soon, when the nearby gutters and drains are filled with water, the water is sure to enter the houses. When the level of water increases and it starts entering the courtyard of the house, people start taking their livestock to the higher and safer places.

c. The direction of the wind also indicates the coming of rain, when the wind is blown from east to west, sweeping the cloud towards western direction, people predicts that the level of the river water will increase.

d. The weather becomes very hot and humid before it rains, at this time body becomes hot and sticky.



Black cloud as a mark of environmental signal

Animal behavior

- The villagers are keen observer of the animal behavior. Certain behavior of the animals like reptiles, birds and insects are used for the prediction of rain and flood. Some of the indicators are
- When snakes starts to roam around the homestead areas, people start to expect flood.
- The croaking of frog in a certain unusual manner. Frogs start to croak continuously for about a month before the flood and croaking stops only when the level of water rises.
- When ants start moving to higher places like trees carrying their eggs, flood is expected very soon.
- When the pelican birds start flying south to north, rain is expected in the coming days. When the bird fly from north to south, rain stops falling in the next day or so even if it has been raining for quite some days.
- Other than the pelican birds, when other species of birds which are not usually seen the village and the neighbouring areas are seen in the village, people knows that it is raining in the higher mountainous places. Thus, people expect flood due to rise in the level of the water in the river. When these birds start moving away from the village, people predicts the coming of rain.

- Usually the bird Koyal (cuckoo) is easily sighted in the village and its sound can be heard every morning and night. When these birds move away from the village, people come to know that rain is coming.



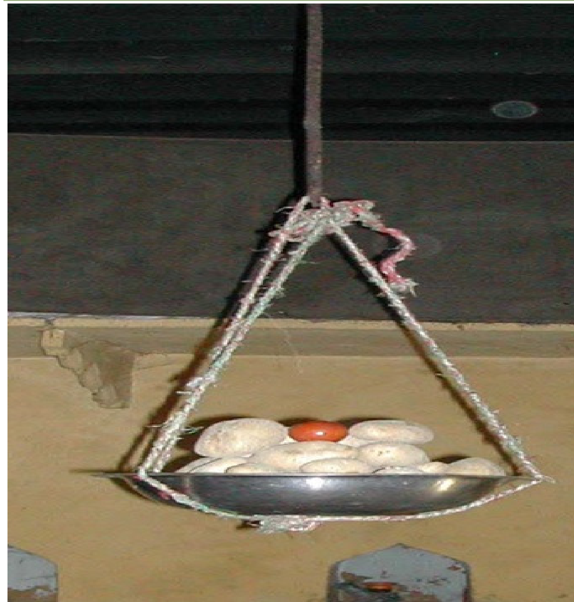
Departure of Koyal from the nest – a signal of impending rain

6.2.12 Community response to floods

As the villagers have been experiencing flood every year, people have developed their system of anticipation, preparation, coping and recovery. In all these overlapping systems of response, people have heavily depended on their indigenous knowledge. Consequently, every flood experiences have enriched their knowledge which could be applicable in mitigating the flood risk.

Preparing for the flood

The villagers have been experiencing flood every year so preparation starts as soon or before the rainy season starts. Families try to store as much food as they can. Women of the house prepare to store foods and firewood.



Storing flood items at higher places during floods

The capacity to store food depends entirely on the economic condition of the family. However, those who could not afford by themselves borrow from the moneylender to buy food items.



Storing fodder at rooftops

Enough fodder for the cows are stored in the higher and dry places. Male members of the family are responsible for collecting fodder for the cows and they usually go to the river bank for collecting fodders. (See Role of family members during flood)



MACHAN FOR STORING COW DUNG CAKES AND FIREWOOD

Most of the time cow dung cakes are made and dried so that it could be used during the flood. Women of the family start grinding flour, buy pulses and salts, storing vegetables.



MACHAN BUILT INSIDE THE HOUSE TO KEEP UTENSILS AND VALUABLE ITEMS

Most of the household also have permanent elevated platforms to stores valuable items.

Coping during the flood

In fact, preparation measures helps in successful coping during the flooding. The local technology of building Machan and lifting the Khatiya or the charpai by tying with rope on the beam which supports the roof are the concrete coping strategies. The portable Chulla, Pihan and Takkat (the wooden platform seen the picture) are indispensible tools for coping with flood.



VILLAGERS DEMONSTRATING THE WAY THEY COOK DURING FLOOD

"*During the flood we usually do not stay inside the house, for the fear that it may break, so we put the Takkat at the open space adjacent to the house. Then the whole family sit and sleep on the Takkat. Cooking is also done on the takkat.*"(Prem Kashyap, 74)



The other coping strategies are basically related with the behavioural change. People generally deviate from the normal behaviour. They eat foods that take less time to cook. Sometimes, they take only one meal a day or cook for both day and night together at once. When the tube well is inundated they use the flood water for cooking and drinking. Sometimes people eat only corns and spend the whole day.

"*Sometimes I do not eat anything for the fear of going to toilet in public. When the water level is high and water run with high speed, it is not safe to go at far off places*."(Ruprani Devi,20)

Thus people cope with flood by changing their normal behaviour pattern. At such a time

Having swimming skill also adds to their coping capacity because in the village people rely only on two boats. According to the villagers, locally made rafts do not works as the water is very wavy and flows with high speed.

Recovery after the Flood

Relief and recovery work start as soon as the water recedes. According to the villagers, they have not been getting enough relief material from the external agencies. Sometimes, government use to distribute rice and sugar but the amount is not sufficient. Few years back, an NGO distributed six hundred rupees and a big plastic sheet for each and every household. This was the only remarkable relief material, the villagers has ever received. Now the NGO has stopped working in the village.

As, the villagers are not getting enough help for recovery, they had to bring themselves back into the normal condition. Soon the whole routine of daily life continues with men folks starting to look out for job opportunity to earn money and women on the other hand resume to their duty of looking after the domestic chores and the children and if there is an opportunity to earn money, they never miss to grasp it. All the wears and tears and destruction caused by the flood water are gradually attended.



A man carrying the portable housing material for shifting to another place

This cycle of preparation, coping and recovery carries on throughout the year and repeatedly each year until and unless there is major destruction like cutting of houses and land. In case, the houses are destroyed people try rebuilding their houses at a safer place. For this they had to go through lots of hardship and struggle. In fact, there are 39 household in the village which do not have land of their own to build houses. They are taking refuse at the side of the dam

6.2.13 Indigenous knowledge, perceptions and practices

Perceptions are on the basis of views and opinion expressed by the villagers during the group discussion and semi structured interview.

Perception among the men of the community

- God is angry with us, most of us follow the norm of the society and nobody tries to break it. We pray to the every possible god, but the situation is worsening day by day.
- We should thank to the god that, even though we are suffering a lot, there has not been much casualty due to flood in the past decades.
- We still strictly follow all the rituals associated with the festivals, every adult man and women keep fast during the Navratri for 9 days which is held twice a year, even the young children keep fast if they want to. We try to maintain the rituals in all the festivals as far as possible. Not only in the festivals but also every Sunday, every adult female of the family do Puja and keep fast on this day. Nowadays this is not more in practice among the younger generations.
- The village was a business centre at one time because it was suitable for the goods to be transported by boat. It was an advantage to be near the river. It



has provided a lot of wealth to our ancestors but now the river has taken it back again

- We pray to the Ganga Mata, a day has never gone by without praying to the goddess. Everyday whenever we go out to collect fodder for the animals from the riverbank, we pray to her for our safety
- Now we relaying on our skill and knowledge because neither the god nor the government is helping us
- Most of us cannot afford to give education to our children and those who have read up to secondary level with great support from their parents are roaming around the village unemployed. So, it is better to teach them to learn labour work.
- As for the indigenous agricultural practices, we have good knowledge about variety of crops. At one time, there was moisture in the soil and everything whatever was planted produced good yield but now once the flood water recedes, the soil become very dry.
- At the present condition, we can grow watermelon at the sand deposits at the riverbank but nobody grows because, nobody wants to take risk and one has to keep vigil throughout day and night. It may tempt people to pluck unnoticed and there is always a possibility of conflict.
- We can also plant bamboo trees as it is a very important raw material for building houses and other material objects. But we cannot plant it in large scale because the homestead area is very small and if planted near the houses, it is very dangerous as it attracts lots of snakes. We also cannot plant at agricultural land because there is not much land left for planting crops.
- Now we grow those crops which can resist the flood water or those which grow during the dry seasons and plantation is only for subsistence because there is not much land left for surplus production to gain profit.
- Most of us relay on chemical fertiliser as soil fertility has decreased but those who cannot afford still relay on indigenously made manures from cow dung.
- Before planting any crop, we pray to god and after the harvest of crops, we offer to the god. In fact, before venturing to any new project we always take the name of the god.
- Even though we pray to god, he is neither helping us nor the government official, we have come to know that government has provided enough support material but it does not reach to the villagers.



- Not only the relief materials are reached here, but also exact amount of ration and kerosene is never given. These are given less than the exact amount that also in the higher price
- At one time there use to lots of trees at the bank of the river but flood has taken all of that. Even the biggest trees are washed away by the flood water. Now there are still some mangroves near the river.
- Before the situation of the flood was not this worse. It has worsened due to the opening of dam from Nepal.
- The flood water is very intense and wavy so the raft made up of banana trees and bamboo does not work. So, people manage with two boats in the village, one is owned by the Pradhan and another one is owned by Rajaram yadev.
- We have this knowledge that the situation can be improved if cemented embankments of the river is made or we could keep heaps of stone near the river bank. But we do not have enough resource of our own to do that. That is why we are saying only the god and government can help us.
- We rely on our beliefs about prediction of rain and flood because this the only way for us. The government people do not inform about the opening of dam.

Perceptions among the women of the community

- No matter how much Puja we do or how much fast we keep, flood never stops to come but we are still carrying on with the hope that it will be better someday but every year the situation has worsen.
- The river has become our enemy; it has taken away our land, house, peace of mind and everything.
- Now everything is in the hand of the God whether he relief us or not. The other one is the government, if they provide enough support, we will able to improve our livelihood.
- Now we pray to give enough strength to us and our family members to face the problems.
- Today women have started working in agricultural field. At one time women usually do not work outside the house. Women are paid Rs 30 -35 per day as wage for the labour.
- At one time women did not learn to swim. We are also less privileged in learning to swim because we do not go to play at the river. Now most of us have learnt to swim and we also encourage other women to learn swimming.



- We also try to know about home remedies for the minor illness like cold, fever, pain in the throat etc because there is no proper treatment centre in the village. And whatever we know we try to share with others.
- We actually do not have much to save but whatever we could, we try to buy jewelleries which we can always sell at the time of need.
- Now the younger generation is moving out of the village to earn money, it is very risky to go out and earn but we cannot stop them because there is limited opportunity in the village. Some of them have migrated for good but it is hard to live in cities because we don't have no one to relay on. But in the village when we don't have anything to eat, we can always ask the neighbours. So, here no one gets to sleep with empty stomach. But in the city, the day you don't earn, you have nothing to eat.
- During the flood we face lots of problem, there is no proper place to relief oneself of the natural calls. Sometimes we do not eat for two three days for the fear of defecating in the public and it is not safe to go far and isolated place when it has been inundated by water.
- Even though we face lot of problems and sorrow due to flood, we console ourselves that it not alone us who is suffering but there are also many other more villagers and people of neighbouring village who are also suffering.
- When the flood water was surrounding us from all the side, we sat saliently praying to the god to let the water recede as soon as possible so that we could move back to our normal life and earn more.

Perception among the educated people

- We cannot wholly discard our indigenous beliefs and practices. Most of the time when our elders says it is going to rain, it always rain.
- We also cannot belief blindly on any superstitious things. Once, a saint came to our village, he was called 'Akhete Baba'. One of his hand was lifted up and he show that he has divine power. He used to remove ghee (purified butter) from his Lotta (a brass jug with handle to carry water). He promised that he can stop the coming of flood and remove all the sorrows of the villagers. All the villagers prayed to him and lots of money was offered to him. But it was of no use, the flood came the next year itself.
- No matter how scientifically developed we are, the villagers always follow the agricultural calendar used by our ancestors.
- The education system in the village is very poor, so it is difficult to compete with other in matters of searching job.



- Support from the NGOs and government agencies are very poor. So, the intervention of the external agencies is very much required in order to improve the economic condition of the people
- When the people are struggling to earn two time meal, there is no way people can think of building an embankment
- There are food crops like sugarcane which can resist the flood water and which also give enough profit. Such kind of crop can be grown more but, people fear that there won't be enough land for cultivating food grains for consumption.
- The education level of the villagers is very low and on top of the political organization of the village is powerless. So far, the villagers have not been receiving any pension scheme neither for the old age nor the handicap people.
- News about the opening of barrage is usually given the district level officials but it never reaches the village. We only come to know when the water level rises.
- In such condition, our indigenous warning signals and preparation beforehand always helps.

6.2. Key findings and analysis of the strength and weakness of the indigenous knowledge practices

It is been clearly seen that the villagers of Golaganj has become so adapted to the flood to the extent that, it is no more considered as an abnormal condition. Thus flood has become an integral part of the daily life of this people. There is no doubt that the villagers have so far been coping on their own without much support from the external agencies. Adaptation has been seen in every possible form whether it is in economic practices, planning of family, marriage practices or the religious practices. Besides they have also developed indigenous technologies in terms of housing and other material objects. When all these beliefs, practices and technologies are objectively analysed it has its own positive and negative aspects. A brief strength and weakness analysis of the indigenously developed belief and practices is discussed below.

- The family structure in the village shows that joint families are disintegrated into nuclear family. This has an advantage in the sense that, the parents do not bear the responsibility of their son after marriage and a man become more responsible to establish and look after his own family. This also avoids the possibilities of



chaos and conflict between the daughters in laws who have come from different families. Despite all the advantages, it may deprive the sense of oneness between the siblings and the habit of pooling and sharing the economic burden.

- People have developed this notion that having a large nuclear family is advantageous for division of labour and sharing of burden and hence they can better cope with the deteriorating environmental and economic condition. So, having more number of sons is considered fortunate. But this may lead to sexual disparity and decline in the sex ratio and may lead to social problem like female foeticide. This aspect has not been covered in the present study but requires an in depth study. Encouraging women to have more number of children may cause a detrimental impact on the health of the women. On the other hand, feeding and looking after more number of children is not an easy task if the father is the sole bread earner and the children may suffer from nutritional deficiencies which may cause serious disease thereby causing more economic and mental instability.

- The society has developed a systematic way of division of labour between the members of family in every aspect of everyday life including income earning. Each member has been assigned different role and task in different time and space. This has the advantage of creating coherence and cooperation in the everyday life and also in facing and coping with the flood. But the declining economic condition has compelled women to work outside for wage thereby giving an additional role to them. This may cause over exhaustion and stress among the women thereby affecting their health.
- The villager beliefs that they rely on their relatives and kin members at the time of need. They take financial help and emotional support from their relatives. But it is not commendable to seek help from the same person when one is facing the same problem every year. So, the help gets exhausted after a considerable period of time. On top of that, when the same groups of relatives are facing the same disaster, one never expects to help each other because maintaining self becomes the first priority.
- In terms of the marriage practice caste endogamy is strictly practiced and marrying a woman of lower caste is strictly prohibited. This further enhances the caste disparity. However, in the recent years, few cases of inter-caste marriage has come up which the villagers have accepted without much resistance. In due course of time this practice may be encouraged to abolish caste hierarchy.
- Marrying women from dry village (the term used by the villager for those places not affected by flood) and giving daughter to dry village is highly preferred and practiced among the people of Golaganj. This helps in expanding their social ties and increases their social capacity. But the all male youth of the village are not



lucky enough to get a spouse from other village or women from the village itself as nobody wants to their daughter to live in this flood affected area. The people have also expressed about the difficulty in finding brides. This may lead to decline in the morality and sexual behaviour of the youth and also lead to an increase in social problem like rape and extra marital affairs.

- The villagers are being compelled to cut down the marriage expenses and the wedding ceremonies are not done elaborately. On top of these the dowry system is no more in trend. This has many positive aspects and saves both money and time which can be invested in other productive work. Daughters from both the rich and poor family have equal chances of getting married.
- The villagers have strong beliefs in the God and Goddess. They believe very unexplainable phenomena to be creation of God. They strictly follow all the rituals associated with each and every festival. The advantage of this may be the fact that it brings peace of mind and acts as a source of recreation. But on the other hand fasting is very common in most of the festivals; people keep fast for nine days during the Navratri, which is celebrated twice a year. Keeping fast on Sunday is generally practiced by the women of the village. All these practices if seen objectively can be considered as a system of increasing the endurance power and coping mechanism. On the contrary, this may greatly affect the health of the people especially the pregnant women and the feeding mother.
- In terms of the economic practices, the villagers have adopted agricultural practices which are best suited for the present environmental conditions which need further encouragement from the external agencies so that producing capacity may be increased. Besides they have great knowledge about the crops that can be best grown. But the only limitation found is that people no more think about surplus and gaining profit, it is rather substantive. They are also avoiding to plant fruits like watermelon, which they know is suitable to grow in the sand deposits near riverbank for the fear of conflict. So, there is a need to uplift their agricultural approach.
- Diversification of income by migration of male family member for earning is very much practiced among the villagers. In fact most of the household are relaying on the money remitted by the migrated members. This has tremendously helped in maintaining the day to day life of the villagers. Such practice may be further increased to enhance their livelihood and standard of living.
- Fishing so far has not been practiced as an income earning work rather it is done for the consumption only. There are no ponds or fisheries for cultivating fish in the village. But the villagers have developed the skill of knitting net and fishing



in the river. These skills of the people can be further encouraged. In addition to these activities, micro finance scheme can be integrated.

- People have also developed the skills of making houses that are best suited to adapt to the flood. These houses are cost effective and can be made from the locally available materials. Beside both the man and women have developed knowledge and skills for making material objects which enable them to adapt to the changing environmental conditions. These need to be formalised and transmitted to younger generations and the masses.
- Peoples also beliefs that learning to swim is a must and majority think that children should be encouraged to learn to do labour work and develop other skills except for the few who wants to encourage education. Learning to swim to increase coping capacity can be encouraged but the wrong notion of the people about not promoting education is definitely due to the poor economic condition and unavailability of proper education system in the village and the neighbouring village. So, the intervention of outsider is really needed in this situation.

As discussed above, the people have developed certain social, cultural, economic and technological adaptive strategies. Besides people have well coordinated system in terms of preparation, coping and recovery, the three core steps of human response to flood which the younger generation are learning consciously or unconsciously. However, it has not been documented properly but it is being passed down from generation to generations. All these skills, beliefs and practices are part of indigenous knowledge of the people of Golaganj.

Even though, the preparation process, the coping strategies and the way how their parents have tried to recover after the flood can be observed and learned by the children but there is certain system of knowledge which is not concrete. It cannot be seen or learnt until and unless one probes into the mind of the older generations. Most of the younger generation do not know the environmental signals about anticipating rain and flood neither they try to learn. Here, the village elders have good knowledge about predicting weather by looking at the animal behaviour and changes in the environmental conditions as mentioned above. But this knowledge was found to be confined only among the few and it has not been properly disseminated among the mass. Yet the younger generations acknowledge the fact that whenever the elders tell them, it is going to rain, rain never fails to come. Thus indigenous knowledge has always been reliable in terms of predicting rains and floods. At the present time there is a need to formally document and disseminate such system of knowledge.



Thus the inhabitants or the villagers of the Golaganj has been studied in terms of their socio-cultural behaviour, religious beliefs and practices and also the way how they are maintaining their livelihood have been scrutinised. And it has been found that each behaviour and practices are meaningful in the context of their cultural beliefs. If these cultural beliefs are viewed objectively by an outsider; it may not be always advantageous and meaningful to the society concern. Nonetheless, indigenous knowledge about weather prediction and also other related social, cultural and technological knowledge can be incorporated in developing a people friendly plan and policies in flood management or other developmental programme. Incorporation of indigenous knowledge will help in the empowerment of the local people and their development thereby increasing their self sufficiency and strengthening their capacity and self determination. This will definitely bring about a developmental change without hurting the religious and cultural sentiment of the people concern.

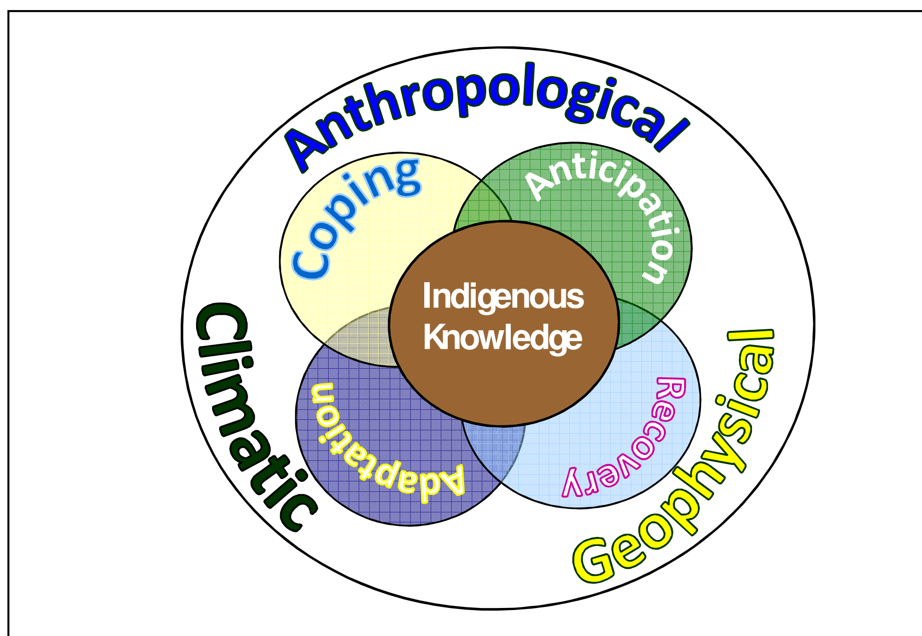
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Chapter 7

Indigeneous Knowledge for Community Based Disaster Risk Reduction

7.1 Introduction

It's evident that the indigenous knowledge, a product of anthropological, geophysical (location/place) and climate attributes, truly empowers a community in terms of having definite risk reduction strategies viz., anticipation, coping, adaptation and recovery.



Indigenous knowledge contributing to disaster risk reduction in terms of anticipation, coping, adaptation and recovery

The four case studies drawn from the seismic Himalayan region of Nepal, coastal hazard areas of Sri Lanka, flood and drought prone regions of India illustrate clearly that the communities normally put to use the indigenous knowledge to anticipate natural hazard that afflicts them. Anticipation and prediction make the community better prepared to face the impact of the disaster. When a disaster hits them, they respond, adapt and cope using their indigenous knowledge. After this, when the

impact is brought under control, the community starts to recover and try to return back to normal. Recovery is generally made up of post disaster activities wherein the community tries to mitigate the risk when the next disaster hits, which in one way ensure less vulnerability of the community. Indigenous knowledge thus enables a community to respond to the natural disasters in the form of anticipation, coping, adaptation and recovery.

Therefore it is clearly established in the present study that a community relies on their indigenous knowledge, which includes predicating the weather and the disaster by looking at the changes in the environmental condition and the animal behaviour, developing capacities to deal with the disasters, best method to preserve food, developing expertise in house building technique, developing strong ties with friends and relatives whom they can call for assistance, developing alternative source of income etc. They also best utilise the resources at their disposal like food stocks, animals, cash, jewellery, lands and other valuable items which can be borrowed, lend or sold. Communities used most of their strategies and resources before taking the help of the external agencies. So the communities having strong knowledge, skill and capacity to anticipate, cope, adapt and recover are less vulnerable to the risk of the disaster.

I. Key Challenges

The basic problems of integrating indigenous knowledge in disaster risk reduction is that such knowledge are mostly transmitted orally from one generation to another and are not properly documented and that there are wide varieties and divergences of such knowledge which cannot be generalized and recommended for application unless tested and validated in the changing contexts and situations. Therefore, the first essential task is to document such knowledge and practices in all their dimensions - social, economic, technical and cultural -in different agro-climate and natural hazard zones in the region. Documenting these case studies from Nepal, Sri Lanka and India is an effort in this direction.

The further challenges based on such documentation are now development of standard tools and guidelines for scaling up and integration of IK in disaster risk reduction besides examining the effectiveness of such knowledge in the changing contexts and situations and the manner in which such knowledge resource could be integrated into the development schemes and programmes.

In the above context, the key issues to harness the potential of IK include the following[1]:

- Raising awareness: identity – record – disseminate – exchange IK
- Validation and Valuation: study – test-compare – challenge – fund – protect
- Mainstreaming: pilot – adapt – integrate into comprehensive development framework
- Technology transfer: adoption of IK in other locations requires validation
- Building Local Capacity: train – facilitate IK exchange

The areas which need improvements in order to integrate IK in disaster risk reduction could be listed as follows:

- Policy and legal frameworks for incorporating traditional knowledge practices in place
- Collection and compilation of traditional/indigenous knowledge scattered in the country.
- Information, communication and educational strategy to be operational
- Research in traditional knowledge programmes that can be implemented
- Capacity building of stakeholders using existing traditional knowledge
- Institutional mechanism for incorporating/mainstreaming traditional knowledge

Creating awareness and capacity for documentation of indigenous knowledge and mainstreaming such knowledge into the disaster risk reduction practices are the main entry points. It further requires sensitization of decision makers at the national and state levels about the importance of such knowledge for development. The initial responsibility for all these tasks rests with the researchers and practitioners of indigenous knowledge to study, analyze, document and to develop tools and methodologies for the application and test them through pilot projects and demonstrate results of these projects to the world outside to create a demand for scaling up such applications. It is only

[1] Hemanthi Ranasinghe, Indigenous Knowledge in Sri Lanka, 2005

through such systematic and sustained effort that it shall be possible to create the knowledge base which alone can give a push to the adoption of useful indigenous knowledge for sustainable development.

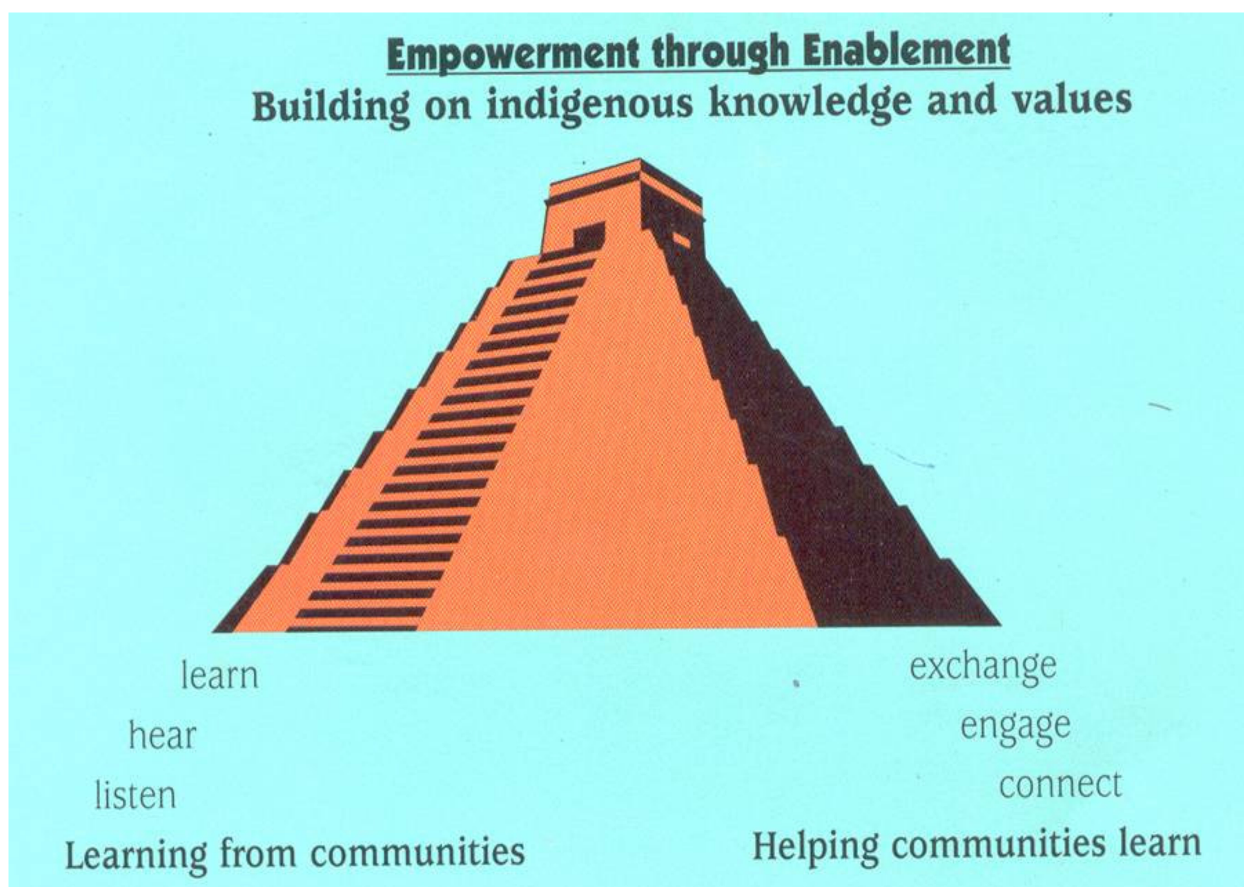
In the above context, India has taken some definite steps and the draft National Policy on Disaster Management with a clear and forthright formulation has the following pronouncement on indigenous knowledge and disaster management:

> *A rich legacy of technical knowledge and experience has been handed down right from ancient times by way of tried and tested principles in facing disasters in different parts of India. A concerted effort shall be made to catalogue this precious knowledge, validate the products through contemporary systems and disseminate the results to appropriate destinations and affected communities with a view adding value to their DM effort.*

II. A Road Ahead

In the simplest form, the road ahead could be summarized towards community empowerment through enablement building on IK based disaster risk reduction strategies starting based the learning from communities by listening and hearing them to the exchange, engage and connect them for further empowerment. It should be two way processes where community is the giver of indigenous knowledge as well as recipient of scientific knowledge, which complements and enriches their own knowledge resources.

While communities are the repositories of indigenous knowledge on disaster risk reduction, they are yet engage fully in manner that this knowledge should get integrated in risk reduction strategies. Communities are required to encourage reviving; adapting and using such knowledge, to the extent it is possible, in the community based disaster risk reduction (CBDRR) programmes. The communities are the reservoir of time tested knowledge of coping with risks and disasters which need to be documented and linked with scientific knowledge in a two way process in which scientists learn from the indigenous coping mechanism and communities are benefited from scientific knowledge. The present study is an attempt in that direction.



While CBDRR provides opportunity to dovetail indigenous knowledge for disaster risk reduction, it is important to recognize the vitality of this issue and populate further as a strategy for mainstreaming risk reduction at community level. The current status of implementation of CBDRR strategies and initiatives in South Asia region was reviewed during SAARC Regional Workshop on Community based Disaster Management in Dhaka during November 19-20, 2007. The highlights and the main lessons learnt from these experiences as discussed during the Workshop are the followings (www.sdmc-nic.in/roadmaps):

- CBDRR in South Asia is relatively new. Bangladesh was the first to start the process through the Cyclone Preparedness Programme (CPP) in the coastal districts in 1972. India started its Disaster Risk Management (DRM) in 169 multi-hazard districts in 2002. Other countries have started the process only recently.
- Wherever the CBDRR has been under implementation for some time positive gains have been made in reducing the risks of disaster. In Bangladesh the CPP created massive awareness among the communities

about the risks and enhanced their capacities to be prepared and respond to disasters, which is reflected in the drastic reduction in casualties in subsequent disasters. In India the communities covered under the programme have performed better than those which were not.

- CBDRR has done better in countries where the national and local governments have been proactively involved with the implementation of the programmes.
- CBDRR has done better in countries where this is institutionalized with local self governing institutions and integrated with local and national level planning mechanisms.
- In almost all the countries CBDRR has been taken up largely through the initiative of international/ national NGOs, UNDP etc, and in some countries in collaboration with the national governments. CPP in Bangladesh was started by the International Federation of Red Cross and Red Crescent Society and DRM was started in India by the UNDP which is also the driving force of the programmes in Afghanistan, Bhutan, Nepal and Bangladesh. In Sri Lanka and Pakistan the programme was taken up under tsunami and earthquake recovery programmes funded by the donor agencies. CBDRR has mostly been taken up on a project mode and has not been integrated within the existing governance and development programmes for their long term sustainability.
- In none of the countries CBDRR extends to all the communities living in risks and therefore there is a need to upscale the programme to all such communities and also to lay emphasis on integration of indigenous knowledge in CBDRR. The special needs of communities at risk in island, mountains and in thickly congested urban areas and vulnerable groups like children, physically and mentally challenged and senior citizens have not been adequately addressed.
- The communities are the reservoir of time tested knowledge of coping with risks and disasters which need to be documented and linked with scientific knowledge in a two way process in which scientists learn from the indigenous coping mechanism and communities are benefited from scientific knowledge.

A saga of knowledge that includes both indigenous knowledge and explicit knowledge is required to put in action for disaster risk reduction at the community level. There are examples where merging of IK with scientific knowledge has worked well on the ground. For example, the ICT based rural telecentres set-up in chronic multi-hazard areas with appropriate, locale specific contextual, products and services have been found helpful not only in merging IK and explicit knowledge and also disseminating them to the community at

risk. The interactive nature of rural telecentres mixes seamlessly both of them and transfers instantaneously to the end-users at act upon. India, with operational rural telecentres in disaster prone areas, exemplifies this trend[2]. While it is always desirable to merge community owned indigenous knowledge and coping with explicit knowledge from the continuing advances in science & technology, realizing this in real life situations has always been quite challenging. The CBDRR in South Asia provides an opportunity to empower the community enriching their own knowledge base and integrating them with scientific knowledge.

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[2] Sanjay Srivastava, Rural Telecentres in Disaster Risk Reduction, Disasters (in Press) to be published in 2010.



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ANNEX 4
BIBLIOGRAPHY: INDIGENOUS KNOWLEDGE ON FLOOD

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